DOCUMENT RESUME

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ABSTRACT

This publication contains details of 18 science topics based upon the general science objectives stated by the Working Party on Secondary School Science for pupils in the third and fourth years of Scottish secondary schools who do not intend to take courses leading to the Scottish Certificate of Education examinations (see SE 015 432). The topics are intended to form part of 16 possible school courses such as Marketing, Fabric and Fashion, Minerals and Gemstones, Building, and Health and Recreation. A chart indicating the courses in which each science topic may be included is given. For each topic there is a general introduction, indicating the links with the science course for the previous two years and the general goals of the topic; a detailed syllabus; and additional notes and/or references for teacher and student. The detailed syllabus contains a synoptic statement of content, explanatory notes, and suggested laboratory and home investigations. The topics included are Microbiology; Marine Biology; Fresh Water Biology; Plant Science; Nutrition; Human Sciences; Earth Sciences; Fuels; Dyes; Corrosion; Surface Science; Photographic Science; Optics; Astronomy; Weather Science; Flow; Electrical Circuits; and Electronics. (AL)

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SCIENCE TOPICS FOR THIRD AND FOURTH YEAR NON-S.C.E. CO

1. In Curriculum Paper No. 7 of the Consultative Committee on the Curriculum ('Scien H.M.S.O. June 1969) considerable attention was given to the place of science in th for those pupils not intending to sit for Scottish Certificate of Education Examinatio objectives and specimens of science topics to indicate the form and content which the S Science considered suitable for this group of pupils. There was also in this report a which the Working Party intended eventually to publish to assist schools in preparing s is included as part of this present publication.

2. The science topics included here represent the bulk of those indicated on the cha any school to provide a full year's science study in any of the school courses inc are:

1. Microbiology
2. Marine Biology
3. Fresh Water Biology
4. Plant Science
5. Nutrition
6. Human Sciences
7. Earth Science
8. Fuels
9. Dyes
10. Corrosion
11. Surface Science
12. Photographic Science
13. Optics
14. Astronomy
15. Weather Science
16. Flow
17. Electric Circuits
18. Electronics

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FOR THIRD AND FOURTH YEAR NON-S.C.E. COURSES

ive Committee on the Curriculum ('Science for General Education', published by
was given to the place of science in the second cycle of secondary education
ish Certificate of Education Examinations. This included a set of general
ndicate the form and content which the S.E.D. Working Party on Secondary
upils. There was also in this report a chart indicating the various topics
publish to assist schools in preparing suitable courses of study. This chart
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the bulk of those indicated on the chart and should be sufficient to allow
e study in any of the school courses indicated. Those topics included here

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nce

3. Several other topics are in various stages of preparation and will be issued at a

19. Genetics
20. Hygiene and Physiology
21. Ergonomics
22. Ecology
23. Husbandry
24. Gemstones
25. Metals
26 Polymers
27. Cosmetics
28. Cookery Science
29. Strength of Materials
30. Sound.

4. Apparatus lists for these topics are being produced by the Scottish Schools Scien be available as soon as possible. It is not intended to issue either Worksheets

5. The use of these topics has been described fully in Curriculum Paper No. 7. Each but no topic need be covered in full unless the class shows interest or unless th material is necessary for an adequate understanding of the subject matter. It is hope for projects arising from some of the work indicated and will allow time for the open- approach requires.

ous stages of preparation and will be issued at a later date. These are:

s
and Physiology
ics

ry
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s
cs
Science
n of Materials

are being produced by the Scottish Schools Science Equipment Research Centre and will
. It is not intended to issue either Worksheets or memoranda to accompany these topics.

described fully in Curriculum Paper No. 7. Each topic represents about six weeks work
full unless the class shows interest or unless the teacher considers that all of the
understanding of the subject matter. It is hoped that teachers will see source material
work indicated and will allow time for the open-ended development which a project

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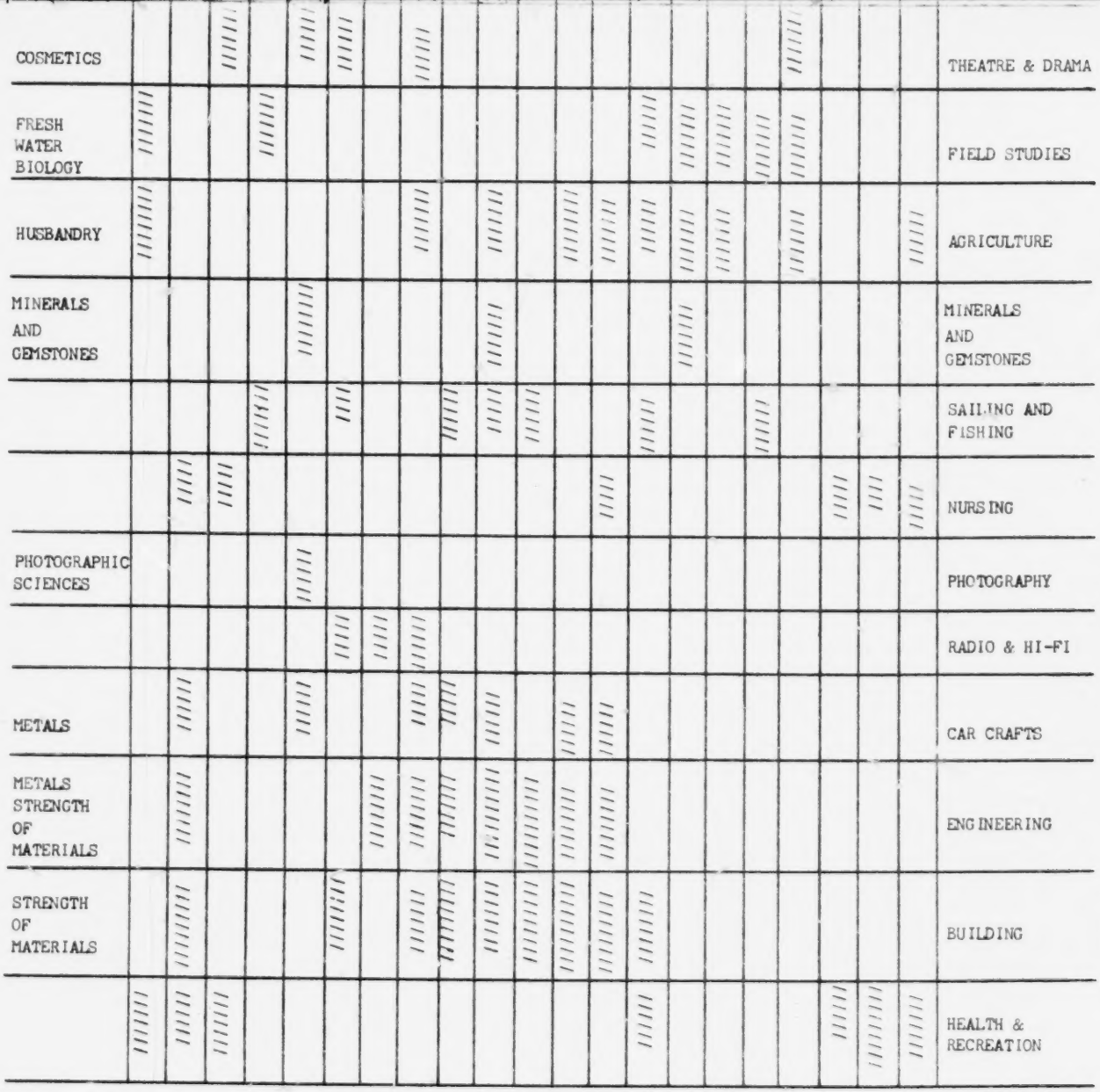
SCHOOL COURSES → / SCIENCE TOPICS ↓	MARKETING	DINNERS & DINERS	FABRIC & FASHION	BEAUTY CULTURE	THEATRE & DRAMA	FIELD STUDIES	AGRICULTURE	MINERALS AND GEMSTONES	SAILING AND FISHING	NURSING
MICROBIOLOGY	//////	//////	//////	////			//////			//////
HYGIENE & PHYS.	/////	//////		//////						////
NUTRITION		/////		/////						/////
PLANT SCIENCE					///////	///////	///////			
MARINE BIOLOGY						///////			//////	
GENETICS						///////	///////			
EARTH SCIENCE						///////	///////	///////		
WEATHER SCIENCE						//////	//////		//////	
SURFACE SCIENCE	///////		//////////				///////			//////
FUELS							///////			
POLYMERS			/////////						//////	
CORROSION	//////	/////					//////	///////	/////	
FLOW									//////	
ELECTRIC CIRCUITS					//////		//////			
ELECTRONICS										
SOUND	///////				//////				////	
OPTICS	//////		/////////	//////	//////			///////		
ASTRONOMY						///////			///////	
HUMAN SCIENCES	//////	//////	//////////	//////	///////					//////
ERGONOMICS	///////									//////
ECOLOGY						///////	///////			
SCIENCE TOPICS ↑ / SPECIAL TOPICS →		COOKERY SCIENCE	DYEING STRENGTH OF MATERIALS	COSMETICS	COSMETICS	FRESH WATER BIOLOGY	HUSBANDRY	MINERALS AND GEMSTONES		


COSMETICS
FRESH WATER BIOLOGY
HUSBANDRY
MINERALS AND GEMSTONES
PHOTOGRAPHIC SCIENCES
METALS
METALS STRENGTH OF MATERIALS
STRENGTH OF MATERIALS
THEATRE & DRAMA
FIELD STUDIES
AGRICULTURE
MINERALS AND GEMSTONES
SAILING AND FISHING
NURSING
PHOTOGRAPHY
RADIO & HI-FI
CAR CRAFTS
ENGINEERING
BUILDING
HEALTH & RECREATION

1. MICRO-BIOLOGY

Introduction

This section on micro-biology follows directly from work done in Year established. Two branches of work have been developed (1) micro-bilogical of micro-organisms.

(1) The study of food contamination leads to experiments and discussi shops and the home. As this part of the work involves many small groups, each group treating a prepared petri dish or other medium ments can be discussed at both group and class level. There shou bacteria.

(2) The second part of the work, useful applications of micro-organis organisms are harmful. Many are very useful and play an importan factories where food is prepared, to breweries, sewage works, dai

A large section of this course can be linked with Homecraft classes.

SAFETY

Petri dishes containing bacteria can be handled, after any bacteria or done, by the teacher, by placing a piece of filter paper soaked in formalin dish is needed. The formalin kills and preserves any bacteria. However, c any petri dishes.

Contaminated dishes should be placed in a bucket of ten per cent hysol autoclaved to destroy them.

Emphasis should be placed on washing hands after handling contaminated licking labels, should be avoided until hands have been washed.

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1. MICRO-BIOLOGY

ows directly from work done in Year II where the presence of micro-organisms was
been developed (1) micro-bilogical contamination of food and (2) useful applications

on leads to experiments and discussions on personal hygiene, cleanliness in factories
part of the work involves many small experiments, the pupils can be divided into
prepared petri dish or other medium in a different way. The results of the experi-
n group and class level. There should be no attempt to stain or identify any

useful applications of micro-organisms, should demonstrate that not all micro-
are very useful and play an important role in certain industries. Visits to local
red, to breweries, sewage works, dairies or creameries may be undertaken.

be linked with Homecraft classes.

n be handled, after any bacteria or fungi in them have been killed. This can be
e of filter paper soaked in formalin into the petri dish, one or two days before the
preserves any bacteria. However, care should be taken not to remove the lid from

ed in a bucket of ten per cent hysol after use. Disposable petri dishes can be

g hands after handling contaminated apparatus. All hand to mouth operations e.g.
hands have been washed.

SYLLABUS	EXPLANATORY NOTES
(1) Contamination of food by bacteria and fungi.	Establish the conditions necessary for the growth of micro-organisms
Bacteria multiply in certain foods causing these foods to go bad.	(a) food
	(b) water
	(c) suitable temperature.

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
		P = Small group or individual experiment. S = Stations method. D = Demonstration experiment.
h the conditions necessary for th of micro-organisms		
d	P	Set up flasks containing (1) distilled water, (2) water containing a meat extract. Leave flasks open. Examine after one week.
er	P	Put bread in each of four petri dishes. Leave the bread in one dry, add varying amounts of water to the others. Leave the dishes open for 20 minutes, cover, and leave in a dark cupboard for one week. Examine fungal growth. Set up dishes containing a variety of dried and fresh foods e.g. plums, prunes, grapes, raisins, fresh meat, lentils, dried peas, potato etc. Leave the dishes open for one day, cover, then examine after one week.
table temperature.	P	Set up flasks of beef extract at different temperatures e.g. in a fridge, at room temperature, in an incubator at 37°C. Examine after one week.

SYLLABUS	EXPLANATORY NOTES
	Sources of Bacterial contamination. (1) By air (see Year II). A comparative and quantitative approach can be made by growing bacteria on prepared petri dishes and counting the number of colonies growing on the agar. Bacteria settle from the air. (2) By man. Personal hygiene. Washing even with medicated soap reduces but does not eliminate bacteria. Use of a deodorant - odour is caused by bacterial action on sweat.
Reduction/prevention of food contamination.	Growth of micro-organisms can be reduced in food by removing the conditions needed for active growth. Hygiene in the home, shops, factories.

TES		SUGGESTED PRACTICAL WORK
tamination.		
). uantitative e by growing i petri dishes mber of the agar.	P	Expose petri dishes on a window sill, in a cupboard, on a bench, in various rooms throughout the school.
air.	P	Expose petri dishes at various heights in the laboratory. Compare number of colonies on each.
	P	Touch surface of agar with fingers, place hair scrapings from behind finger nails and from between teeth of a comb on surface of agar.
ted soap reduces acteria.	P	Touch surface of agar with dirty hands, hands washed with ordinary soap, with medicated soap, hands dried on a towel, above hot air etc. Touch surface of agar with towel used to dry dishes.
ur is caused weat.	P	Wrap a piece of polythene around a finger until sweat is produced. Touch the surface of agar in two sterile petri dishes with the 'sweaty' finger. Spray one dish with deodorant. After incubation, compare the number of bacterial colonies on each.
s can be reduced onditions needed		
os, factories.		

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SYLLABUS	EXPLANATORY NOTES		
	Use of disinfectants.	P/D	Rub anot area ster
		D	Remo belo tube disi take
	Use of preservatives.	P	Plac vine week
	Effect of temperature. High temperature kills bacteria, freezing only inactivates them.	D	Heat auto samp keep
	Preservation on industrial scale - canning, packing, drying etc.		
(2) Micro-organisms used by man	Role played by yeast in baking.	P	Prep obse
	Brewing and wine making.	P	Make
	Role played by bacteria in making of cheese and yoghurt.	D	Prep half plat bact sepa clea a bo salt

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
Disinfectants.	P/D	Rub one part of bench top with a cloth, scrub another part with disinfectant, leave one area untouched. Rub each area with a sterile swab, transfer to surface of agar.
	D	Remove a sample of liquid from the U bend below a sink. With a long sterile glass tube, transfer to surface of agar. Pour disinfectant down drain, leave for one hour, take a second sample.
reservatives.	P	Place samples of meat or other food in vinegar, salt, water. Examine after one week.
f temperature. High temperature cteria, freezing only inactivates	D	Heat beef broth in a pressure cooker or autoclave, for 15 minutes, warm a further sample, place a third in a deep freeze, keep flasks plugged, examine after one week.
tion on industrial scale - canning, drying etc.		
yed by yeast in baking.	P	Prepare dough with and without yeast, observe, and bake both samples of dough.
and wine making.	P	Make wine using fruit extract and yeast.
yed by bacteria in making of nd yoghurt.	D	Prepare cheese from milk as follows. Take half a pint of sour milk - make a streak plate using the milk to show the presence of bacteria. Warm milk gently, until it separates into curds and whey. Strain into clean muslin, tie up and allow to drip into a bowl. Remove cheese from muslin, add salt.

SYLLABUS	EXPLANATORY NOTES	
		D Dilu stre bact
Possible long term project	Action of antibiotic.	
	Succession in fungi.	P Plac zing for cupl grow of be is

PLANATORY NOTES	SUGGESTED PRACTICAL WORK
	D Dilute a sample of live yoghurt and make a streak plate to show the presence of bacteria.
tibiotic.	
n fungi.	P Place the various moist foods in crystallizing dishes. Expose each to the atmosphere for one hour, cover and leave in a dark cupboard. After one week observe fungi growing on each food. Estimate the amount of each kind of fungus. The fungi need not be identified. A simple description of each is enough.

Media suitable for the growth of micro-organisms.

(a) Nutrient broth -

(1) Lab lemco (yeast extract) 10 g

peptone 10 g

sodium chloride 5 g

water 1 litre

(2) Marmite

peptone

sodium chloride

water

If the nutrient broth is cloudy it must be filtered until it is clear.

(3) Nutrient broth from 'Oxoid'

(b) Agar for petri dishes -

(1) for bacteria - blood agar base

(2) for bacteria in milk - MacConkey's agar

(3) for gungi - malt agar or blood agar base.

2. MARINE BIOLOGY

Introduction

The seashore makes an excellent place for educational visits and for those schools
should take place, whenever possible, during the early years of secondary school. Thus
history of the sea can be engendered before a pupil arrives in non-certificate science c
of the work should not be academic, organised visits will be essential and timetabling s
are facilitated. It will be necessary to arrange that some of the plants and animals sh
periods of time, within the laboratory itself. The work should not be confined to the s
will occur when local fishing activities can be integrated into the work and visits made
public aquarium if one is within reasonable reach of the school.

Teachers intending to use 'Marine Biology' as a topic should note that much useful
field-work, and environmental projects in general, can be found in the S.E.D. Memorandum
Schools" (1966). There is also a useful chapter on Marine Biology in the S.E.D. publica
Schools" (1961).

The need for conservation should be stressed whenever suitable occasions arise, ind
should be avoided at all times. The cumulative effect of even the minimum of collecting
'exploring' etc. can damage or even destroy an environment if too much educational use i

2. MARINE BIOLOGY

place for educational visits and for those schools situated in coastal areas such visits during the early years of secondary school. Thus a general interest in the natural before a pupil arrives in non-certificate science classes in SIII and SIV. Treatment rganised visits will be essential and timetabling should be arranged so that such visits y to arrange that some of the plants and animals should be kept in aquaria, for suitable y itself. The work should not be confined to the shore and laboratory; opportunities ies can be integrated into the work and visits made to a marine biological station or a onable reach of the school.

e Biology' as a topic should note that much useful information on the organisation of s in general, can be found in the S.E.D. Memorandum "Field-work in Biology for Secondary ful chapter on Marine Biology in the S.E.D. publication "Nautical Subjects in Secondary

be stressed whenever suitable occasions arise, indiscriminate collecting of specimens cumulative effect of even the minimum of collecting, stone turning, rock pool estroy an environment if too much educational use is made of it.

SYLLABUS	EXPLANATORY NOTES	SUGGESTED PRA
(1) Visits to Seashore Habitat (At least two half-day visits will be needed for this part of the work. Some of the work lends itself to group work and it is not envisaged that each student should cover all this work on the beach - considerable use should be made of follow-up display work etc.)	Habitat Information	P Number of O.S. she of shore visited.
		P Notes on weather,
		P Rocks - size, colo moved by water or and/or animals.
		P Sand - grain size, or not, patterns,
		P Tides, time of H/W HWM - how many and
		P Make sketches and
		P Collect objects fr
	Seaweeds - red - green - brown	P Collect, note where or washed up.
	Animals	P Collect (as appropr (i) on rocks (incl (ii) under rocks, (iii) on seaweeds, (iv) under seaweeds (v) on and in sand (vi) on and in mud
	Rock pool	P Initial observation pool, collect and

RY NOTES	SUGGESTED PRACTICAL WORK
	P Number of O.S. sheet used. Grid reference of shore visited.
	P Notes on weather, waves, visible coastline.
	P Rocks - size, colour, rough or smooth, moved by water or not, colonised by plants and/or animals.
	P Sand - grain size, colour, moved by waves or not, patterns, organisms growing on sand.
	P Tides, time of H/W and L/W from tables. HWM - how many and why.
	P Make sketches and maps of beach visited.
	P Collect objects from H.W.M.
een - brown	P Collect, note where found and whether fixed or washed up.
	P Collect (as appropriate to beach visited). (i) on rocks (including burrowers into), (ii) under rocks, (iii) on seaweeds, (iv) under seaweeds, (v) on and in sandy areas, (vi) on and in muddy areas.
	P Initial observations, make sketch map of pool, collect and record plants and animals.

SYLLABUS	EXPLANATORY NOTES		SUGGESTED
(2) Laboratory work based on material collected on the seashore.	Seaweeds - Keys should be made specially for locality to be visited.	P	Identify and mak species collecte that may be atta
		P	Make a collectio
	See "The Seashore" by V.E. Ford for details.	P	Extract pigments
	Fertilisation may be seen.	P	Look for reprodu eggs and sperm u
		P	Keep small weeds
	Animals - Keys should be constructed for locality visited.	P	Try to identify
	Set up as rock pools, well oxygenated water needed. See S.S.S.E.R.C. Bulletin No. 6	P	Keep suitable sp
	Try to return as many as possible to sea before they die.	P	Make observation preserve single collection.
			(i) methods of (ii) methods of (iii) methods of (iv) methods of (v) methods of (vi) methods of

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
us - Keys should be made specially for locality to be visited.	P	Identify and make simple sketches of common species collected. Look for organisms that may be attached.
	P	Make a collection of mounts.
See "The Seashore" by V.E. Ford for details.	P	Extract pigments, test for carbohydrates.
Fertilisation may be seen.	P	Look for reproductive structures - view eggs and sperm under microscope.
	P	Keep small weeds in marine aquaria.
s - Keys should be constructed for locality visited.	P	Try to identify using simple pictorial keys.
Set up as rock pools, well oxygenated water needed. See S.S.S.E.R.C. Bulletin No. 6	P	Keep suitable species in marine aquaria.
Try to return as many as possible to sea before they die.	P	Make observations on other species and preserve single specimens for reference collection. (i) methods of locomotion, (ii) methods of feeding, (iii) methods of respiration, (iv) methods of defence, (v) methods of preventing desiccation, (vi) methods of resisting wave action.

SYLLABUS	EXPLANATORY NOTES		SUGGESTED
(3) Project work which can be carried out on future visits to habitat and/or in follow-up in laboratory	Distribution of plants and animals.		
	(a) spatially	P	Simple line tran
	Record plants and animals at regular intervals. (e.g. 1 metre possibly, also a belt transect).		
N.B. It is not intended that all these lines of study should be developed. Such project work also is a good opportunity for groups of two, three or four pupils to work together.	(b) numerical	P	Sampling techniq numbers of a par intervals down a
	(c) seasonal	P	Use transect and different season or absence of sp of particular sp
	Rock pool - If possible compare and contrast two (or more) from different areas of the beach, do not choose large ones.	P	Sketch shapes.
		P	Record weather d
		P	Take water tempe regular interval
		P	Transect studies
	Soil testing outfit for litmus papers. SG methods.	P	Remove samples o
	Man-made features	P	Distribution maps groynes, pier sup
		P	Use of man-made
	Natural features	P	Distribution maps rocks, in caves.

XPLANATORY NOTES		SUGGESTED PRACTICAL WORK
n of plants and animals.		
lly	P	Simple line transect from above HWM to LWM.
plants and animals at regular ls. (e.g. 1 metre possibly, belt transect).		
al	P	Sampling techniques to compare population numbers of a particular species e.g. regular intervals down a sandy beach.
l	P	Use transect and sample techniques at different seasons of year - record presence or absence of species, changes in numbers of particular species.
If possible compare and contrast two (or more) from different areas of the beach, do not choose large ones.	P	Sketch shapes.
	P	Record weather details during visits.
	P	Take water temperature readings (^{o}C) at regular intervals during visits.
	P	Transect studies.
Soil testing outfit for litmus papers. SG methods.	P	Remove samples of water for (i) PH (ii) Salinity (iii) O2 content
tures	P	Distribution maps of species on breakwaters, groynes, pier supports etc.
	P	Use of man-made features.
Natural features	P	Distribution maps of species on large rocks, in caves.

SYLLABUS	EXPLANATORY NOTES		SUGGESTED
(3) Project work (Contd.)	Animal Visitors to Beach	P	Observations an other visitors
	'Homing' studies	P	'Marking' experi whelks, limpets,
	Plankton Useful contacts can be established with local fishermen, pier and harbour authorities etc.	P	Collect from wa LWM.
	Sand-dunes etc. (Shingle banks, salt marches) Study should include characteristics which enable flowering plants to survive in such seashore habitats.	P	Transect studies information abo including man's
	Pebbles See Minerals and Gemstones for further development of this aspect.	P	Examine stones, pebbles and rock out for fossils.
	Seaweed 'holdfasts'	P	Collect samples communities fou
	Colonisation and Succession.	P	Clear standard a and study the co result.
	Local fishing industry. 'Fish' in this context includes edible 'shellfish'.	P	Find out from lo from books:- (i) methods of (ii) species of and demer (iii) local fishi (iv) marketing o

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
sitors to Beach	P	Observations and notes on birds seen and other visitors such as insects and mammals.
studies	P	'Marking' experiments with periwinkles, dog whelks, limpets.
	P	Collect from waves at LWM, or from below LWM.
contacts can be established cal fishermen, pier and authorities etc.		
etc. (Shingle banks, nes)	P	Transect studies from HWM inland, collect information about area behind shore including man's influence
hould include characteristics iable flowering plants to in such seashore habitats.		
	P	Examine stones, rocks and cliffs. Collect pebbles and rock specimens. Keep an eye out for fossils.
erals and Gemstones for development of this aspect.		
holdfasts'	P	Collect samples and study the animal communities found in association with them.
ion and Succession.	P	Clear standard areas of visible organisms and study the community changes which result.
ning industry.	P	Find out from local fishermen and also from books:-
n this context includes 'shellfish'.		(i) methods of fishing used, (ii) species of fish caught (both pelagic and demersal), (iii) local fishing grounds, (iv) marketing of the catch.

SYLLABUS	EXPLANATORY NOTES
	Economic uses of seaweeds.

ANATORY NOTES	SUGGESTED PRACTICAL WORK
of seaweeds.	(i) Food value.
	(ii) Historic importance as sources of potassium and iodine.
	(iii) Agar-agar.
	(iv) Industrial uses of carrageen.
	(v) Alginates in industry.

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Materials and Apparatus

O.S. maps and geological maps.
Pie dishes or white plastic dishes.
Sieves, fishing nets, plankton net.
Garden fork, trowel, spade.
Magnetic compass.
Plastic bags.
Plastic containers (especially tubes) - not glass.
Pencils, including chinagraph, notebooks.
Quick-drying paint or nail varnish.
String or rope, preferably nylon.
Penknife.
Rulers, transparent protractors.
Binoculars.
Hand lenses.
Spirit level.
Thermometer (^{o}C).
Polythene buckets.
Polythene screw-top containers for sea water.
Glass tanks.
Aerators.
Small paint brushes.
Gum.
Formaldehyde.
Screw-top jars.
Museum boxes.
Soil pH outfit or litmus papers.
Tape measure.
Metre square grids of strings.
Microscopes, including binocular type.
Suitable paper for mounting seaweeds.

APPENDIX

(A) Visual Aids

(i) Films

"Discovering the Seashore" - Scottish Central Film Library
"Between the Tides" - British Transport Films
"The Sea"
"The Seashore"
"Seashore Ecology"
"Creel Fishing in Scotland"
"Modern Trawling"
"Animals of the Rocky Shore" - Scottish Central Film Library

(ii) Filmstrips

"Life on the Seashore" - Educational Productions
"Flowers of the Coast" - Educational Productions
"Some Common British Seaweeds" - Educational Productions
"Know the Land XIII : Sea Coast" - Visual Publications

(iii) 8 mm Film Loops

"Collecting on the Sea Bed"
"Animals of the Sandy Shore"
"Life on a Rocky Shore"
"Tide Pool Life - Parts I and II"
"Collecting Plankton"
"Sea-Anemone - Feeding"
"Crustaceans"
"Coelenterates and Sponges"
"Echinoderms and Sea Squirt"
"Molluscs"

(iv) Transparencies

"Sea Shore Ecology" by B.D. Lewis comprises 44 slides of Rocky Shore Ecology and 33 of S
obtainable from Philip Harris Ltd., 63 Ludgate Hill, Birmingham 3.

The transparencies of Marine Life taken by Dr. D.P. Wilson which were obtainable from Fl
be purchased through W.J. Garnett, Breezemount, Ringrash, Macosquin, Coleraine, N. Ire

eashore" - Scottish Central Film Library
" - British Transport Films

Scotland"

cky Shore" - Scottish Central Film Library

ore" - Educational Productions
ast" - Educational Productions
sh Seaweeds" - Educational Productions
I : Sea Coast" - Visual Publications

Sea Bed"
ndy Shore"
hore"
Parts I and II"
on"
ding"

Sponges"
ea Squirt"

" by B.D. Lewis comprises 44 slides of Rocky Shore Ecology and 33 of Sandy Shore Ecology - Philip Harris Ltd., 63 Ludgate Hill, Birmingham 3.

of Marine Life taken by Dr. D.P. Wilson which were obtainable from Flatters and Garnett can now ough W.J. Garnett, Breezemount, Ringrash, Macosquin, Coleraine, N. Ireland.

(v) Charts

"Plaice, Herring and Mackeral" - Educational Productions
"Jellyfish, Starfish and Crab" - Educational Productions
"Cod fish and Haddock" - Educational Productions
"Lobster, Shrimp and Hermit Crab" - Educational Productions
"Shark" - Educational Productions
"The Blue Whale" - Educational Productions
"Sea Fishes (European and Atlantic)" - Scandinavian Fishing Year-Book
"Edible Molluscs and Crustaceans (World)" - " " " "
"Delicacies from the Sea" - Scandinavian Fishing Year-Book
"Fishing Banks in the N. Atlantic" - Scandinavian Fishing Year-Book

(B) Books

"The Seashore", F.M. Haworth, published by University of London Press
"Seashore Life", Leaflet No. 15, by the School Natural Science Society, obtainable from M.J. Gardens, Upminister, Essex
"Creatures of the Seashore", Educational Productions
"Between the Tides", Street, University of London Press
"Seashore Ecology", Miles and Miles, Hulton Educational Press
"How to Begin Your Field Work - The Seashore", V.E. Ford, Association for Science Education,
"Plants and Animals of the Seashore", Prud'Homme van Reine, published by Murray
"The Young Specialist Looks at ..... Seashore", Kosch, Frieling and Janus, Published by Burke
"The Young Specialist Looks at ..... Marine Life", W. de Haas and F. Know, published by Burke
"The Pebbles on the Beach", C. Ellis; Faber and Faber
"Pocket Guide to the Seashore", Barrett & Young; Collins
"Life of the Shore and Shallow Sea", Wilson; Ivor Nicholson and Watson
"The Sea Shore", Yonge, Collins New Naturalist Series
"Flowers of the Coast", I. Hepburn, Collins New Naturalist Series
"The Open Sea", A.C. Hardy, Collins New Naturalist Series
"British Seaweeds", Dickinson, Eyre and Spottiswoode (Kew Series)
"The Littoral Fauna of Great Britain", Eales, Cambridge University Press
"The British Seashore", Vevers; Routledge and Kegan Paul
"Deep Sea Fishing", J.M. Wright; Black
"The Deep Sea Fisherman", I.E. Allison; Educational Supply Association

Educational Productions
Educational Productions
nal Productions
" - Educational Productions

oductions
c)" - Scandinavian Fishing Year-Book
(World)" - " " " "
inavian Fishing Year-Book
" - Scandinavian Fishing Year-Book

d by University of London Press
e School Natural Science Society, obtainable from M.J. Wootton, 44 Claremont

al Productions
y of London Press
ulton Educational Press
ashore", V.E. Ford, Association for Science Education, John Murray
Prud'Homme van Reine, published by Murray
ashore", Kosch, Frieling and Janus, Published by Burke
arine Life", W. de Haas and F. Know, published by Burke
Faber and Faber
t & Young; Collins
ilson; Ivor Nicholson and Watson
turalist Series
llins New Naturalist Series
w Naturalist Series
d Spottiswoode (Kew Series)
Eales, Cambridge University Press
dge and Kegan Paul

; Educational Supply Association

(C) Useful Addresses

Scottish Marine Biological Association, Millport, Isle of Cumbrae

The Gatty Marine Laboratory, St. Andrew's, Fife

Unilever Ltd., Education Section, Information Division, Blackfriars, London, E.C.4. (bookle

White Fish Authority, Lincoln's Inn Chambers, 2-3 Cursitor Street, London, E.C.4. (various

Aberdeen Fish Market Publicity Association, Aberdeen

Scandinavian Fishing Year-Book, 25 Strandgade, Copenhagen K, Denmark.

n, Millport, Isle of Cumbrae

ew's, Fife

ormation Division, Blackfriars, London, E.C.4. (booklet - "Sea Harvest")

hambers, 2-3 Cursitor Street, London, E.C.4. (various booklets)

ation, Aberdeen

randgade, Copenhagen K, Denmark.

3. FRESH-WATER BIOLOGY

Introduction

The choice of this topic will depend to a great extent on the availability of suitable ha school. This factor will also determine whether sections 1 and 2 are both studied in equal de to greater depth. The school pond, a hitherto much neglected feature, can become the centre o structed, stocked and maintained. Otherwise day - or half-day excursions to the habitat selec many cases a stream and pond can be found adjacent to each other, so that class studies on the Half the class might collect and study organisms from each ecosystem, and the findings might l tion for the other half of the class.

Studies in the field could include making simple maps of the area, transects across strea tive estimates of e.g. snails or Gammarus in two different habitats.

Organisms suitable for study under section A, pupil experiments*, include:

(a) Feeding: Dytiscus beetles and their larvae, water-boatmen (Notenecta), water scorpio will catch and eat tadpoles and worms. Hydra will eat water-fleas. Fish will eat w pond-snails eat Elodea, and leave "radula-tracks" on alga-covered acuarium glass. T water mussels can be shown using Indian ink.

(b) Movement: All animals listed under (a), also flatworms, pond-skaters, etc.

(c) Breathing: Air-breathers such as pond-snails, beetles, water-boatmen can be contrast caddis-larvae and mayfly larvae.

(d) Life-cycles: Pond-snails frequently lay gelatinous egg-masses on sides of aquaria. or young may be seen in living Daphnia. Some leeches have a humped appearance which or young carried on the ventral surface. Other leeches, and flatworms, lay egg-caps Caddis larvae pupate by sealing the ends of the tube. A cage over the water will ca Stickleback courting behaviour and egg-laying may be seen in a large aquarium.

Other subjects for study might include: Response to light of Planarians, colour-change with ba Minnow) and frog, and microscopic examination of plankton and mud samples. Living Daphnia und the heart and circulation, eye and eye-muscles, brood-pouch, antennae for movement and the gut plant food, peristalsis visible).

The problems of water-supply and pollution are extremely important to-day. Discussion of of conservation, a theme which should permeate the whole of fresh-water studies.

3. FRESH-WATER BIOLOGY

eat extent on the availability of suitable habitats within easy reach of the
ections 1 and 2 are both studied in equal detail, or one of these studied
ch neglected feature, can become the centre of this study if properly con-
- or half-day excursions to the habitat selected should be arranged. In
t to each other, so that class studies on the two habitats may run parellel.
from each ecosystem, and the findings might later be arranged as a demonstra-

mple maps of the area, transects across stream or edge of pond and quantita-
different habitats.

, pupil experiments*, include:

vae, water-boatmen (Notenecta), water scorpions, dragonfly nymphs - these
Hydra will eat water-fleas. Fish will eat worms, Daphnia, etc. Large
a-tracks" on alga-covered acuarium glass. The feeding-currents of fresh
ink.

, also flatworms, pond-skaters, etc.

nails, beetles, water-boatmen can be contrasted with gill-breathing fish,

gelatinous egg-masses on sides of aquaria. Brood-pouches containing eggs
Some leeches have a humped appearance which is due to a clutch of eggs
. Other leeches, and flatworms, lay egg-capsules attached to stones.
s of the tube. A cage over the water will catch the adults as they emerge.
aying may be seen in a large aquarium.

o light of Planarians, colour-change with background in fish (Bullhead,
lankton and mud samples. Living Daphnia under the microscope will show
ood-pouch, antennae for movement and the gut (green colour indicating

e extremely important to-day. Discussion of these should stress the idea
whole of fresh-water studies.

Commercial fisheries in ponds and lakes are less common in Britain than elsewhere, b
briefly discussed. Salmon and trout - fishing in Scottish rivers provide perhaps the nea
A visit to a salmon-ladder of trout-hatchery is worthwhile. Any discussion of angling wo
the part of teacher or pupils, and would be a suitable place for contributions by interes

Details of the life-histories of parasites are not required in the final section, th
of the cycle is usually of interest to the pupils. Frogs, pond-snails and fish often har
demonstrate the parasitic relationship.

onds and lakes are less common in Britain than elsewhere, but the principles behind them may be
trout - fishing in Scottish rivers provide perhaps the nearest approach to fish cultivation.
trout-hatchery is worthwhile. Any discussion of angling would depend on special knowledge on
and would be a suitable place for contributions by interested pupils.

ries of parasites are not required in the final section, though some idea of the complexity
erest to the pupils. Frogs, pond-snails and fish often harbour a selection of creatures which
tionship.

SYLLABUS	EXPLANATORY NOTES	SUGGEST
(A) Fresh Water Habitats (1) Still Water - ponds and lochs	Visits to suitable sites should familiarise pupils with general features of habitat and various sub-divisions within it.	P Visits (sever selected prev
	The flora and fauna collected should be studied and maintained in the laboratory in conditions as near to natural ones as possible. Simple records should be kept of all investigations carried out on each type of organism.	S Collection of different gro situations wi face, mud, un Conservation times.
	Hand-lenses, binocular microscopes and "O-grade type" student microscopes should be available at all times during the laboratory investigations.	P Set up aquari in the labora separately an pupal stages
		P Identify as m possible, usi
		*P Using a few o observation a (a) what it (b) how it m (c) how it b (d) any deta
		P/D Set up artifi polythene tan structed scho collected, an out the year e.g. water-fl algae, etc.

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
sits to suitable sites should familiarise pils with general features of habitat and rious sub-divisions within it.	P	Visits (several) to pond, canal or loch selected previously by teacher.
e flora and fauna collected should be udied and maintained in the laboratory conditions as near to natural ones as ssible. Simple records should be kept all investigations carried out on each pe of organism.	S	Collection of plants and animals by different groups of pupils from different situations within habitat, e.g. water surface, mud, under stones, in weeds, etc. Conservation should be emphasised at all times.
nd-lenses, binocular microscopes and -grade type" student microscopes should available at all times during the boratory investigations.	P	Set up aquaria (including jars, beakers) in the laboratory, keeping large animals separately and also isolating eggs and pupal stages for observation.
	P	Identify as many plants and animals as possible, using keys and illustrated books.
	*P	Using a few of the animals, find out by observation and experiment:- (a) what it feeds on, (b) how it moves, (c) how it breathes, (d) any details of life-history.
	P/D	Set up artificial ponds in old sinks or polythene tanks (or in a properly constructed school pond). Stock with animals collected, and observe at intervals throughout the year for changes in population of, e.g. water-fleas, snails, filamentous algae, etc.

SYLLABUS	EXPLANATORY NOTES		SUGGESTED
(2) Running water Streams and rivers.	Visits and investigations as for still water habitat.	D	Set up artificia Investigate colo substrates by, e
(B) Fresh Water and Man			
(1) Water supply	Simple account of problems: huge volumes required, purity necessary (no harmful chemicals, no taste, smell, no pathogenic bacteria). Problem of storage: algicides, coagulants. Filter beds. Chlorination. Reduction of water-wastage.		Visit to reservo
(2) Pollution and Sewage Disposal	Problems of waste: domestic and industrial. Poisons; bacteria and the using-up of oxygen; detergents and foaming. Purification: (1) settling pits, sedimentation tanks, percolating filters with organisms to cause breakdown.		Visit to Sewage
		P	Pollution of pon sugar, etc. Elo
		D	Compare normal a less oxygen in p pyrogallol).
	(2) Activated Sludge; agitation to oxygenate, settlement, return of some sludge to start culture again.	P	Effect of lime o (clay suspension
			Film: The River
(3) Fresh-water Fisheries	Methods of improving F.W. fisheries: fertilising ponds, culling fish if over-abundant, trout hatcheries.		Visit to trout h
		P	Rearing trout-eg
(4) Angling	Fly-fishing as a leisure activity.	P	Examine trout fl

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
and investigations as for still water .	D	Set up artificial stream in laboratory. Investigate colonisation of different substrates by, e.g., Gammarus.
account of problems: huge volumes d, purity necessary (no harmful ls, no taste, smell, no pathogenic a). Problem of storage: algicides, nts. Filter beds. Chlorination. on of water-wastage.		Visit to reservoir and waterworks.
s of waste: domestic and industrial. ; bacteria and the using-up of detergents and foaming. ation: (1) settling pits, sedi- on tanks, percolating filters with ms to cause breakdown.		Visit to Sewage Works.
	P	Pollution of pond-water with detergent, sugar, etc. Elodea dies.
	D	Compare normal and polluted tanks - less oxygen in polluted (brown colour with pyrogallol).
(2) Activated Sludge; on to oxygenate, settlement, return sludge to start culture again.	P	Effect of lime on small suspended particles (clay suspension).
		Film: The River Must Live
of improving F.W. fisheries: sing ponds, culling fish if over- t, trout hatcheries.		Visit to trout hatchery.
	P	Rearing trout-eggs.
hing as a leisure activity.	P	Examine trout flies and actual insects.

SYLLABUS	EXPLANATORY NOTES		SUGGESTE
(5) Medical Aspects	Parasites found in fresh water and the transmission of disease.	P	Examine Limna to obtain flu
	Discussion of water-borne bacterial diseases. Tropical diseases of humans (blood fluke, Chinese liver fluke) and sheep liver-fluke in Britain).	D	Frog parasites parasites.
		D	Stickleback -

LNATORY NOTES		SUGGESTED PRACTICAL WORK
in fresh water and the disease.	P	Examine Limnaea sp. - crush in watch-glass to obtain fluke stages.
ater-borne bacterial ical diseases of humans hinese liver fluke) and ke in Britain).	D	Frog parasites: lung flukes, gut parasites.
	D	Stickleback - tapeworm.

TOPIC: FRESH-WATER BIOLOGY

References and Useful Books:

(A) Readily available keys suitable for this stage:

(1) End-papers of "Observer's Book of Pond Life"
(2) "School Natural Science" Leaflet No. 8 - Water Animal Identification Sheets
(3) Keys in "Biology by Inquiry" - Clarke et al
(4) Keys in Nuffield Biology Texts
(5) "British Hydras" from "Country-Side", magazine of the British Naturalists' Associati
(6) A Guide to Freshwater Invertebrate Animals" - Macan

(B) Books useful for identification from illustrations: also for background information:

(1) "Pond Dwellers" and "Aquaria" - F.M. Haworth
(2) "Observer's Book of Pond Life" - Clegg
(3) "Pond and Stream Life" - ed. Clegg
(4) "The Young Specialist Looks at Pond Life" - Englehardt
(5) "Animal Life in Fresh Water" - Melanby
(6) "Life in Lakes and Rivers" - Macan and Worthington
(7) "The Freshwater Life of the British Isles" - Clegg

(C) On Pollution:

(1) "The Wastes of Civilisation" - Wylie
(2) "The Biology of Polluted Waters" - Haynes

Film: "The River Must Live" 16 mm sound, colour.

Book from: Petroleum Films Bureau,
4 Brook Street,
Hanover Square,
London, W.C.1.

or from local film libraries.

TOPIC: FRESH-WATER BIOLOGY

this stage:

of Pond Life"	Clegg (Warne)
t No. 8 - Water Animal Identification Sheets	
Clarke et al	(Heinemann)
	(Longmans)
-Side", magazine of the British Naturalists' Association	
ate Animals" - Macan	(Longmans)

illustrations: also for background information:

F.M. Haworth	(University of London Press)
- Clegg	(Warne)
egg	(Blandford)
Pond Life" - Englehardt	(Burke)
Melanby	(Methuen)
can and Worthington	(Collins)
tish Isles" - Clegg	(Warne)
Wylie	(Faber)
" - Haynes	(Liverpool University Press)

und, colour.

4. PLANT SCIENCE

This work begins by posing the question - Where does plant material come from?

It proceeds to show that growth takes place only in certain areas of the plant and that
nature so that a balance can be maintained. This is followed by experiments to show that by
growth in plants, man may use this knowledge for his own benefit, mainly in the production o

	SYLLABUS	EXPLANATORY NOTES		SUG
1.	Growth - Quantitive Measurement	Set up experiments to discover where plant material comes from.	P	Weigh dry plants i remove p soil and loss fro
1.2	Areas of Growth	Set up experiments to find out if plants grow all over at the same rate.	P	Soak Bro Cut them Note whi
			P	Sow Broa mark the
			P	Culture Peas and are appr culture treated tilled wa added; di 24D solut
				The root paper tow a polythe the dark. vals.

4. PLANT SCIENCE

e question - Where does plant material come from?

h takes place only in certain areas of the plant and that this growth is controlled in ntained. This is followed by experiments to show that by gaining knowledge of what causes knowledge for his own benefit, mainly in the production of food.

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
experiments to discover where plant al comes from.	P	Weigh dry soil and seeds. Sow fast growing plants in soil. After four to six weeks remove plants and dry and weigh them. Dry soil and re-weigh it. Has there been any loss from the soil?
experiments to find out if plants ll over at the same rate.	P	Soak Broad Bean seeds in water for one day. Cut them into unequal pieces and sow them. Note which part of the seed grows.
	P	Sow Broad Bean seeds. When roots appear mark them and discover areas of growth.
	P	Culture of root tips. Soak seeds of Garden Peas and germinate them. When root tips are approximately 1 cm long excise them and culture them on paper towels which have been treated with various substances, i.e. distilled water; distilled water and sugar added; distilled water with sugar plus 24D solution. The root tips are placed on the treated paper towels which are then placed inside a polythene bag. They are then placed in the dark. Measurements are taken at intervals.

SYLLABUS	EXPLANATORY NOTES		
		P	Col are whe onl cap the
	Various parts of plants are used to show that growth does take place in special areas.	P	Cut eye wel as reg
		P	Pro
1.3 Control of Growth	By natural means. This can be shown by classroom experiments and in field work. Deep rooting and shallow rooting conditions can be observed if suitable soil profiles are available.	D	Dem see roo
	Effect of light can be observed in the field, i.e. undergrowth in woodlands.	D	Dem rec
		D	Dem hyd
	By artificial control. Various rooting powders can be used including "Steradex" Nos. 1, 2, 3 and L15 and "Strike." Dicotox may be used as a selective weed killer.	P	Tak wit con
			Dem

(PLANATORY NOTES		SUGGESTED PRACTICAL WORK
	P	Coleoptile experiments. Seedlings of oats are produced and are placed in a position where they receive light from one direction only. On each alternate shoot is placed a cap of tinfoil to exclude the light. Note the results.
ts of plants are used to owth does take place in is.	P	Cut potato into pieces, with and without eyes, and plant. Ensure that potatoes are well washed in cold water before doing this as they may have been treated with a growth regulating substance.
	P	Propagate the following plants Stem cuttings of Tradescanthia Root Cuttings of Primula Denticulate Leaf cuttings of Rex Begonia
eans. This can be shown n experiments and in field rooting and shallow rooting an be observed if suitable es are available.	D	Demonstrate the effect of moist soil on seedlings, showing deep rooting and shallow rooting.
ight can be observed in the undergrowth in woodlands.	D	Demonstrate "drawn" seedlings and seedlings receiving maximum light.
	D	Demonstrate phototropism and geotropism and hydropism using S.S.S.E.R.C. Clinostat.
l control. Various rooting be used including "Steradex" and L15 and "Strike." be used as a selective weed	P	Take cuttings of Tradescanthia and treat with various rooting powders, setting up controls. Demonstrate selective weed killer on turfs.

	SYLLABUS	EXPLANATORY NOTES	
1.4	Requirements for Growth	The passage of water in plants and photosynthesis are revised by use of suitable films.	P
			D
		Soil testing is done by using Sudbury Soil Testing Outfit which indicates the Nitrogen, Phosphate and Potash content of a soil sample as well as the pH.	P
1.5	Special Substances Produced during Growth	Test various leaves for Chlorophyll including variegated leaves.	P
			P
		The class is divided into four groups. The first group dealing with leaves, the second group dealing with roots, the third group dealing with fruit and the fourth group dealing with seeds. By use of Work Cards pupils in each group carry out a series of tests.	P

ORY NOTES		SUGGESTED PRACTICAL WORK
er in plants and revised by use	P	Collect samples of soil from various areas and test.
	D	Set up water culture experiments.
ne by using Sudbury t which indicates the e and Potash content s well as the pH.	P	Set up experiments with controls to show the presence of micro organisms in soil. Sow Clover seeds in sterilised soil, and in soil inoculated with nitrofying organisms.
s for Chlorophyll ed leaves.	P	Extract Chlorophyll and examine in spectroscope. (S.S.S.E.R.C. Direct Vision Spectroscope.)
	P	Separate Chlorophyll by Chromatography. (S.S.S.E.R.C. Pupil Chromator)
ed into four groups. aling with leaves, the ng with roots, the g with fruit and the ng with seeds. ds pupils in each series of tests.	P	Test for Starch in leaves. Test for Glucose in leaves Test for Protein in leaves Test for Fat in leaves Test for Vitamin 'C' in leaves Test for Starch in roots Test for Glucose in roots Test for Protein in roots Test for Fat in roots Test for Vitamin 'C' in roots Test for Starch in fruit Test for Clucose in fruit Test for Protein in fruit Test for Fat in fruit Test for Vitamin 'C' in fruit Test for Starch in seeds Test for Glucose in seeds Test for Protein in seeds Test for Fat in seeds Test for Vitamin 'C' in seeds.

	SYLLABUS	EXPLANATORY NOTES		
2.1	Reproduction in Flowering Plants.	Pollination and Fertilisation is revised by the use of suitable films. Dwarf Tomato Plants "Amateur" are used for the various experiments on reproduction.	P/D	Stud lisa foll A. B. C. D.
3.1	Germination	A selection of seeds of various types are obtained and tests made to discover if they are all capable of producing new plants.	P	Seed perc
			P	Trea and and
		By the use of Work Cards a series of experiments on the conditions necessary for germination are carried out by the class.	P P P	Is a Is m Is h
			P	Test Soil John John supe John U.C.
			P	Levi Sand Clay Soil

EXPLANATORY NOTES	SUGGESTED PRACTICAL WORK
nation and Fertilisation is revised e use of suitable films. Dwarf o Plants "Amateur" are used for the us experiments on reproduction.	P/D Study the effects of pollination and fertilisation on Tomato Plants under the following - A. Flowers intact B. Flowers with male parts removed C. Flowers with female parts damaged D. Flowers treated with pre-setting hormone (Fulset, which may be obtained from Boots the Chemist)
ection of seeds of various types are ned and tests made to discover if are all capable of producing new s.	P Seed testing. Test samples of seeds for percentage germination. P Treat samples of seeds by boiling, freezing, and subjecting them to various chemicals, and then test for percentage germination.
e use of Work Cards a series of iments on the conditions necessary ermination are carried out by the .	P Is air necessary for germination? P Is moisture necessary for germination? P Is heat necessary for germination? P Test germination in various types of Garden Soil. John Innes Seed Compost John Innes Seed Compost without chalk and supers. John Innes Potting Compact. U.C. Compost. P Levington Compost Sand Clay Soils with various pH.

5. NUTRITION

This section should be integrated with work in the Homecraft Department.

SYLLABUS	EXPLANATORY NOTES		
(1) FOOD CLASSES AND TESTS	Carbohydrates	P	(a)
	Apply test to pure form of material (e.g. sucrose) first and then to foods brought by pupils. Thus	P	(b)
	show carbohydrates contain carbon hydrogen and oxygen (Bulletin 10, S.S.S.E.R.C.)	P	(c)
		P	(d)
		P	(e)
	Proteins - animal, vegetable	P	Tes alb
	Fats and oils	P	Tra
	Minerals	P	Sil Cal
	Caution - if (P) use $\frac{1}{1000}$ M solution	D) or P)	Pot Tes
	Vitamins	P	Ind
	Dichlorophenol-Indophenol (1g/litre distilled water)		(Ap co co
	Water content - Avoid charring	D	Sho e.g
	Summary - Tabulate results on an analysis sheet.	P	Tes Dry

5. NUTRITION

i work in the Homecraft Department.

ANATORY NOTES		SUGGESTED PRACTICAL WORK
	P	(a) Burn dry samples. Test for carbon dioxide and water.
st to pure form of material rose) first and then to ught by pupils. Thus ohydrates contain carbon and oxygen 10, S.S.S.E.R.C.)	P	(b) Solubility
	P	(c) Iodine test for starch
	P	(d) Clinistix test for glucose
	P	(e) Acid conversion of complex sugars to give glucose test.
mal, vegetable	P	Test samples e.g. milk, mince, peanut with albustix.
	P	Translucent stain on filter paper.
	P	Silica rod test for Potassium, Sodium, Calcium and using cobalt glass.
P) use $\frac{1}{1000}$ M solution	D) or P)	Potassium ferrocyanide: Test for iron.
	P	Indophenol solution test for vitamin C.
henol-Indophenol (1g/litre water)		(Applied quantitatively to compare vitamin content of e.g. lemonade and fruit juice, cooked and uncooked vegetables.)
- Avoid charring	D	Show loss in weight on heating various foods e.g. lettuce.
late results on an ysis sheet.	P	Test one sample for various classes e.g. Dry milk.

SYLLABUS	EXPLANATORY NOTES	
	Diet	F
	Use charts, e.g. Food and Fitness from Marmite Ltd. New Looks Ahead from National Dairy Council Film - Food and Health CGA 76	1 2 3 4 5
	Bovril food charts useful. Group Activity to produce charts.	6
		P M f
(2) DIGESTION	Meaning of digestion	
	Food canal	
	(a) Teeth - types and function. Use Chart	P D f
	(b) Saliva - Results tabulated to show that all pupils may not make ptyalin.	P C P S
		D P
	(c) Stomach	P P
		P R
	(d) Small Intestine Digestion completed.	D E il Re
(3) ASSIMILATION AND USE OF FOOD	(a) Absorption into blood steam Visking tubing is suitable.	D L co of gl

TORY NOTES	SUGGESTED PRACTICAL WORK
	Food required daily
ood and Fitness from om National Dairy d and Health CGA 76 useful. Group e charts.	1. Carbohydrates 2. Proteins 3. Fats 4. Minerals 5. Vitamins 6. Water
	P Make a balanced diet chart for a lunch, etc. from magazine cuttings.
on	
and function. Use Chart	P Draw own dental arrangement. Compare with full adult set.
lts tabulated to show all pupils may not ptya'in.	P Chew a cube of bread to show sweetening taste
	P Saliva - starch experiment
	D Peristaltic action using a balloon
	P Pepsin - protein experiment
	P Rennin - milk experiment
ne Digestion completed.	D Effect of bile in emulsifying fats - illustrate by shaking olive oil and water. Repeat adding caustic soda.
to blood steam g is suitable.	D Leave a semi-permeable bag, thimble or tube containing glucose and starch in a be[illegible] of water and test after a few days for glucose and starch in water.

	SYLLABUS		EXPLANATORY NOTES		S
	(3) (Contd.)	(b)	Conversion of fats and carbohydrates to heat and energy. "Food" Calorie accepted as unit comparing energy values of food. Calorie needs according to age, sex and occupation. Chart - "Englishmen's Diet" Pictorial Charts Film - "Carbohydrate and the Calorie" CGA 81.	P	Nuffiel
		(c)	Protein for growth and repair.		
		(d)	Minerals for keeping the body in good working order.		Deficie calcium
		(e)	Vitamins for health See "Teaching Science or Ordinary Pupils" - Laybourne & Bailey.	P P	Deficie In seas Pupils labels

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
Conversion of fats and carbohydrates to heat and energy. "Food" Calorie accepted as unit comparing energy values of food. Calorie needs according to age, sex and occupation. Chart - "Englishmen's Diet" Pictorial Charts Film - "Carbohydrate and the Calorie" CGA 81.	P	Nuffield calorific value experiment.
Protein for growth and repair.		
Minerals for keeping the body in good working order.		Deficiency effects of minerals e.g. iron, calcium and fluorine.
Vitamins for health See "Teaching Science or Ordinary Pupils" - Laybourne & Bailey.		Deficiency diseases P In season make rose hip syrup. P Pupils make own vitamin charts from food labels and magazine cuttings.

6. HUMAN SCIENCES

Introduction

The intention of this brief course is to attempt to make children more aware of thems
of various groups. In addition it is hoped that they will be able to bring in something o
investigations and constantly be shown the shortcomings of their experiments, both in thei
this course) and in similar implications which may well occur outside the school and in th
situations borne in mind have been such as might arise in nursing and the service industri
as well as those common to every citizen today.

It will be noticed that there is a considerable relationship and cross-reference betw
syllabus.

Experiments marked with an asterisk have been further outlined in the NOTES.

SYLLABUS	EXPLANATORY NOTES			S
(1) Child Development and learning processes				
(i) Child rearing and the family (ref 1)	Very simple treatment required here.		D	Pre-nur
			P*	Observe behavio age gro
(ii) Learning processes	Relate to study habits		P	Using r curve s
(iii) Remembering forgetting (ref 6) and incidental learning	Young people tend to be better at this than adults	(a)	P	Kim's G what co was the
	This can be related to what they want to forget (ref 1, p. 234).	(b)	P	Give a street churche etc.

6. HUMAN SCIENCES

to attempt to make children more aware of themselves as individuals and as members
d that they will be able to bring in something of a scientific method in their
shortcomings of their experiments, both in their experience (as performed for
nich may well occur outside the school and in their own later life. The particular
might arise in nursing and the service industries (shop assistants, waiters, etc.)
day.

siderable relationship and cross-reference between the various sections of this

ve been further outlined in the NOTES.

LANATORY NOTES			SUGGESTED PRACTICAL WORK
eatment required here.		D	Pre-nursing films etc.
		P*	Observe, record and analyse playground behaviour and play patterns for specific age groups.
y habits		P	Using reaction timer, plot typical learning curve showing plateaux.
end to be better at ts	(a)	P	Kim's Game - and then unexpectedly ask (e.g.) what colour was the cotton reel? What was the number of the bus ticket?
lated to what they (ref 1, p. 234).	(b)	P	Give a child a map and ask him to learn the street names, but then ask "How many churches were there? Where was the school?" etc.

SYLLABUS	EXPLANATORY NOTES		SUGGESTE
(iv) Perception memory distortion and illusions (ref 1, pp. 240-251)	Relate to court testimony.	(a) P*	Transmission o
	(see also section (4) of this topic entitled Communication)	(b) P*	Suggestibility picture for a to describe it
	Relate of (e.g.) medical diagnosis of laboratory experiments where tendency is to fit observations into expected patterns.	(c) P	Revision and e (Section II of
(four-five double periods for section)			
(2)			
Assessment			
(i) Personality tests and interviews (ref 1 pp. 197-206)		(a) P*	Compare self-r to self and to point rating s e.g. punctuali
	Introduce by saying that superior considers a junior to be slow, forgetful and a poor operator, whereas colleagues and customers consider him to be kind, considerate etc. and a good operator.	(b) P*	Construct own a good or bad
	How do we assess a good or bad shop assistant, nurse etc.? (See also Section (4) of this topic). Show limitation of questionnaire technique.	(c) P	Construct own choice of jobs microscopes", of such forms Service). App (individuals u of jobs.

EXPLANATORY NOTES			SUGGESTED PRACTICAL WORK
o court testimony.	(a)	P*	Transmission of cat-like drawing.
o section (4) of this titled Communication)	(b)	P*	Suggestibility demonstrated by showing a picture for a short period and ask subject to describe it.
f (e.g.) medical diagnosis atory experiments where is to fit observations ected patterns.	(c)	P	Revision and extensions of various illusions (Section II of Integrated Syllabus).
)			
	(a)	P*	Compare self-rating questionnaire applied to self and to neighbour or complete a five point rating scale on given attributes e.g. punctuality, etc.
e by saying that superior s a junior to be slow, for- nd a poor operator, whereas es and customers consider e kind, considerate etc. and perator.	(b)	P*	Construct own questionnaire to help assess a good or bad sales-assistant, nurse, etc.
e assess a good or bad shop t, nurse etc.? (See also (4) of this topic). Show on of questionnaire e.	(c)	P	Construct own questionnaire to help in choice of jobs, (e.g. "I like looking down microscopes", "I like selling socks", etc. of such forms as used by Youth Employment Service). Apply to another class (individuals unknown) and analyse choice of jobs.

SYLLABUS	EXPLANATORY NOTES			
(ii) Working with other people (ref 1, p. 292)	If desired this could lead to a study of group structures and interpersonal relationships by asked such questions as "whose opinion would you ask?" (one with most prestige) "who do you think would be most useful in an emergency?" (the leader) etc. (ref. 7)		P	Stud and "who one
(four double periods)				
(3) Learning under difficulties			D	One in v dres disc dist ness obje suff lear havi
(i) Effect of physical handicaps (note: although the examples quoted may be applied to nursing; corresponding activities could and should be devised for shop assistants, etc.)				
(ii) Effect of competition and co-operation	ref. 8 Ch. 4 pp. 109-115	(a)	P	Usin (1(i lear cond leav

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
If desired this could lead to a study of group structures and interpersonal relationships by asked such questions as "whose opinion would you ask?" (one with most prestige) "who do you think would be most useful in an emergency?" (the leader) etc. (ref. 7)	P	Study of mutual choices, chains of choice and triangles of choice where each child is "who is your best friend?" and given only one choice.
	D	One child act with e.g. immobilised limb(s) in various named situations (e.g. eating, dressing). Class observe limitations and discuss how 'patient' learns to meet new distuations. This can be extended to blindness, deafness, helplessness (how do you object where you can not object (e.g. suffering from stroke paralysis) having learned a skill what is the reaction to having it done for you (e.g. face washing)?
ref. 8 Ch. 4 pp. 109-115	(a) P	Using the reaction-timer learning situation (1(ii)) compare the effects on the learner of a small audience discouraging, condemning mistakes, rewarding successes or leaving the participant alone.

SYLLABUS		EXPLANATORY NOTES			
(ii)	contd.	(ref. 8 ch. 4 pp. 109-115)	(b)	P	Thr nec ope of rac
(iii)	Effect of group pressure (ref. 5)	(ref. 4 p. 688)		P*	Kno pre
(iv)	Effect of first impressions	(ref. 4 p. 669)		P*	Com imp
(v)	Effect of attitudes (stereotypes)	It can be pointed out that studies of this type help us to improve our understanding of racial and other prejudices and of hostilities between nations.	(a)	P	Eac quo pic the ric A v of
			(b)	P	Usi mor pap of
		(ref. 8 pp. 97-102)	(c)	P*	Ste or
(five double periods)					

EXPLANATORY NOTES			SUGGESTED PRACTICAL WORK
8 ch. 4 pp. 109-115)	(b)	P	Three groups removing wedges from a narrow-necked bottle. Compare effects of co-operation, of conversation being prohibited, of emotional excitement etc. (e.g. team race).
4 p. 688)		P*	Knowing it to be 'wrong', yielding to group pressure to describe it as 'right'.
4 p. 669)		P*	Comparisons of effects of given first impressions.
be pointed out that studies s type help us to improve our tanding of racial and other ices and of hostilities between s.	(a)	P	Each pupil given the same supposed or real quotation from a newspaper article (no picture) and asked to complete rating of the principal (e.g. working or upper class, rich or poor, responsible or carefree etc. A variation could be that different halves of the class could be given differing.
	(b)	P	Using a topical item of news (over one or more days) contrasting versions in different papers can be compared using a check list of attributes about the person reported.
8 pp. 97-102)	(c)	P*	Stereotypes reflect attitudes of acceptance or rejection.

SYLLABUS	EXPLANATORY NOTES	
(4) Communication (ref. 2)	Use of statistics board.	(a) P*
(i) Content analysis of mass media (ref. 8 pp. 88 et seq.)	Reliability of the survey can be questioned and discussed. Relate to practical applications in advertising; propaganda and documentary films etc.	(b) P* (c) P*
(ii) Accuracy - rumours, prejudices and propaganda. (ref. 8 p. 80-86)	of and revise Experiment *(iv)(a) and (b). Relate findings to court of law testimony, to advertising etc.	P*
(two double periods)		
(5) Advertising		
(i) Effect of big advertising		D*
(ii) Effect of packaging on purchaser	Try soap powder effectiveness experiment from 'Hidden Persuaders', Vance Packard, Pelican. (Ref. 3)	(a) D (b) P
(two-four double periods)		
(6) Ergonomics and design		
This is a further topic (in preparation) - largely of application in craft-cen		

EXPLANATORY NOTES			SUGGESTED PRACTICAL WORK
tistics board.	(a)	P*	Distribution of types of programmes.
y of the survey can be d and discussed. Relate al applications in g; propaganda and y films etc.	(b)	P*	Personality characteristics of heroes and villains in mass media.
	(c)	P*	Implied values in some selected radio or TV programmes.
ise Experiment *(iv)(a) Relate findings to aw testimony, to adver- .		P*	Correct transmission of a description or message with analysis of errors, distortions, omissions etc.
		D*	Show pictures with and without the advertised product to different groups and compare effects.
owder effectiveness experi- 'Hidden Persuaders', Vance elican. (Ref. 3)	(a)	D	Shapes, sizes of colours, wrapping etc. (e.g. false bottoms in wine bottles, heights of perfume bottles etc.)
	(b)	P	The above can lead to laboratory investigation into the products themselves and testing their claimed properties (ref. "Which? for Secondary Schools - Maths and Science").

ation) - largely of application in craft-centred interests.

NOTES

OUTLINES OF EXPERIMENTS

Experiment 1 (i)

Questions such as the following may be used to note patterns specific to e.g. children, first year, third year and older children in their playgrounds.

At what age do they play together, throw a ball, catch a ball, climb, play mar age do they stop playing these games? At what times of the year do they play certa

Experiment 1 (iv) (a)

Draw a pattern which has certain features of a cat but otherwise is of a very the picture is asked to draw it from memory and pass his drawing on to the next per The features resembling a cat become more and more cat-like until in some series a is produced, sometimes with cat-like details totally unwarranted by the original pi some of the unusual features of the design, these being accentuated until there is to be unrelated to the cat. Both the familiar features and the unusual ones become

Experiment 1 (iv) (b)

To show suggestibility and unreliability of evidence, questions to be asked sh there in the car?" - when in fact there were none; "Which of the women wore a hat? should further be asked to underline those facts about which they were absolutely c

Experiment 2 (i) (a)

(ref. 7 p. 204) Example of self-rating questionnaire.

In your own opinion, which of the following words apply to you (or neighbour)? emphasis. Put a cross, or two crosses, through any that do not. Leave the rest bl

hardworking ... lively ... shy ... cheerful --- solitary ... wor

(about 30 such adjectives)

OUTLINES OF EXPERIMENTS

may be used to note patterns specific to e.g. infants in Nursery Schools, primary school
older children in their playgrounds.

r, throw a ball, catch a ball, climb, play marbles, conkers, peevers, etc.? At what
? At what times of the year do they play certain games (as above)?

features of a cat but otherwise is of a very unusual design. The first person shown
memory and pass his drawing on to the next person, who in turn draws it from memory.
more and more cat-like until in some series a completely conventional drawing of a cat
details totally unwarranted by the original picture. Other reproductions may stress
esign, these being accentuated until there is a cat, with patterns specifically noted
familiar features and the unusual ones become exaggerated.

liability of evidence, questions to be asked should be such as "How many children were
re were none; "Which of the women wore a hat?" - when in fact none of them did. Pupils
those facts about which they were absolutely certain; ready to swear to it.

-rating questionnaire.

e following words apply to you (or neighbour)? Underline them, and use two lines for
s, through any that do not. Leave the rest blank.

vely ... shy ... cheerful --- solitary ... worrying ... untidy

(about 30 such adjectives)

Experiment 2 (i) (b)

The point should be made that care is required in the choice of questions to be as operators. To do this the children might listen to conversations about (e.g.) sales a hear them and note what people say about them - favourable and unfavourable - from cust press comments, etc.

Only those statements about which there is general agreement should be used to con

Experiment 3 (iii)

A group of three-ten confederates agree to unanimously give a wrong judgement on a chosen subject give opinions on a series of visual judgements. For the chosen card one equal in length to a standard. The subject must give his judgement last. It is found subjects distort their judgements in response to this pressure.

Variations can be attempted by increasing the amount of obvious 'wrongness', the s (e.g. group of one or two or three or more).

If two genuine subjects give 'right' opinions it is usually found sufficient to pr other.

Experiment 3 (iv)

Pupils, before listening to a short (fifteen minute) lecture by a 'guest speaker' note. Half the class are told that he is "a cold person, industrious, critical, practi he is "a warm person, industrious ....." At the end of the lecture they are asked to pleting a prepared card of approximately fifteen attributes (he was popular, funny, fri

Experiment 3 (v) (c)

Lists of about sixteen first names (Charles, Mandy, etc.) are to be matched agains list of sixteen attributes (kind, artistic, fat, etc.).

Also for Americans, pupils are asked to tick their individual choice of appropriat about twelve attributes (hardworking, cruel, etc.). They are then asked to repeat this Using the statistics board a simple analysis can be made followed perhaps by a discussi

that care is required in the choice of questions to be asked to distinguish good from bad
ldren might listen to conversations about (e.g.) sales assistants, wherever they happen to
say about them - favourable and unfavourable - from customers, relatives, other assistants,

ut which there is general agreement should be used to consitute a questionnaire.

ederates agree to unanimously give a wrong judgement on a chosen test card. They and the
n a series of visual judgements. For the chosen card one of three lines is claimed to be
. The subject must give his judgement last. It is found that about one third of all genuine
nts in response to this pressure.

ed by increasing the amount of obvious 'wrongness', the size of the group of confederates
hree or more).

ive 'right' opinions it is usually found sufficient to provide sufficient support for each

to a short (fifteen minute) lecture by a 'guest speaker' are given a short, typed biographical
that he is "a cold person, industrious, critical, practical ....." and the other half that
ous ....." At the end of the lecture they are asked to rate the (same) lecturer by com-
roximately fifteen attributes (he was popular, funny, friendly, interesting, etc.).

(ref. 6 pp. 97-102)

rst names (Charles, Mandy, etc.) are to be matched against adjectives chosen from a given
nd, artistic, fat, etc.).

s are asked to tick their individual choice of appropriate adjectives from a given list of
orking, cruel, etc.). They are then asked to repeat this for say five other nationalities.
imple analysis can be made followed perhaps by a discussion.

Experiment 4 (i) (a)

Give the pupils a set of 'Radio Times' and TV Times or women's magazines cover analysis instructions and recording sheet. Analyse and compare programmes in such serious programmes, panel games, etc. Comparisons in terms of times given to each, considered. Discuss results.

Experiment 4 (i) (b)

Using a number of issues of a women's magazine or TV Western film identify the of personal attributes e.g. age, sex, race, cleanliness, looks, social class, marit on a self-rating personality test (as for Experiment 2 (i) (a). Each character sho

Experiment 4 (i) (c)

It should be arranged beforehand that all members of the class will view or li should be sound-recorded on a tape recorder. When the class meets subsequently, th be) and a collective attempt at analysis can be made. This may not be amenable to can be scored as present/absent or as rewarded/unrewarded.

One intention is to show children just how difficult such an analysis can be.

Experiment 4 (ii)

The class are warned that the purpose of the experiment is to test the accurac to be performed. The first subject as a 150-200 word story read to him (or descript second subject is then called in and the first subject repeats to him what he has h to ten pupils.

Starting with the same original story, comparisons can be made of the final ver If tape recorders are available, each version of each story can be recorded as it is and why omissions and distortions occur.

(ref. 6 pp. 88 et seq.)

and TV Times or women's magazines covering a given period together with sheet of
Analyse and compare programmes in such broad terms as sport, drama, news, music,
arisons in terms of times given to each, from each station during the period

agazine or TV Western film identify the main characters and rate them on a number
cleanliness, looks, social class, marital status, accent, etc. and perhaps also
periment 2 (i) (a). Each character should be rated at least twice.

ll members of the class will view or listen in to a particular programme which
. When the class meets subsequently, the recording can be played back (if need
be made. This may not be amenable to statistical treatment but sets of values
ed/unrewarded.

how difficult such an analysis can be.

f the experiment is to test the accuracy of their memory and how the experiment is
-200 word story read to him (or description of an unseen object given). The
st subject repeats to him what he has heard and so on down a chain of from seven

comparisons can be made of the final versions achieved by different 'chains'.
n of each story can be recorded as it is told and an analysis attempted of when

Experiment 5 (i)

After a large national advertising campaign has been running for a short while can be divided into two similar groups. Each group is shown an apparently innocuou with full shopping bag). The picture shown to one group includes sign of Brand X; almost identical but does not show Brand X. Pupils in each group are asked to writ reports are scrutinised to see who and how many specifically mention Brand X.

(This could then sometimes lead to a further study to see what real difference competitors. For many examples of this type see "Which? For Secondary Schools - Ma Association).

advertising campaign has been running for a short while, for Brand X of some commodity, the class
ilar groups. Each group is shown an apparently innocuous picture (e.g. housewife returning home
he picture shown to one group includes sign of Brand X; the picture shown to the other is
ot show Brand X. Pupils in each group are asked to write descriptions of the picture. These
see who and how many specifically mention Brand X.

imes lead to a further study to see what real difference (if any) there is between Brand X and its
ples of this type see "Which? For Secondary Schools - Maths & Science" published by the Consumers'

Reference

Practical

1. Aids to psychology for nurses (paperback) 10/6d.

   A. Altschul - The Nurses' aids series
   Bailere, Tindall and Cox.

2. Understanding the mass media - N. Tucker - CUP

   (a practical approach for teaching)

3. The Hidden Persuaders - Vance Packard - Pelican

Theoretical

4. Elements of Psychology - D. Krech S.R.S. Crutchfield
   1958 Knupf

5. Social Psychology - Asch - Prentice Hall 1952

6. Remembering - F.C. Bartlett - CUP 1932

7. Psychology of inter-personal behaviour - Argyle - Pelican

8. Social Psychology through experiments - Humphrey & Argyle - Methuen

9. Psychology and social problems - Argyle - Methuen

7. EARTH SCIENCE

	SYLLABUS	EXPLANATORY NOTES		SUGGESTI
(1)	Local environment in different geological ages	Examine class-collection.		Rock types: i morphic. Sec CGA 819.
(2)	Local Geology	Paint according to colour code pink-basalt, blue-limestone etc.		From 1" Geolo enlargement o
		Show stratifications. Discuss hardness and topography.	P	Examine speci in situ where
		Scratching order.	P	Simple experi
		Use crossed polarised light for more effective demonstration (local museum may help here).	D	Examine thin projector, es rocks, if ava
		Film strips to show formation of igneous rocks.	P	Crystallise a projector or
		Earthquake regions - connection with mountain building.	P	Examine fault
		Brief discussion.	P	Point out are Glacial drift
		Formation of glacial drift. Work of water and ice in landscaping, Films, postcards etc., Climbing accidents.		
		Reasons for different rates of growth, local areas of high and low fertility - reasons other than under-lying rock type.	P	Powder variou seeds in each

7. EARTH SCIENCE

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
class-collection.		Rock types: igneous, sedimentary, metamorphic. Section of Frames from FS. CGA 819.
ccording to colour code pink- blue-limestone etc.		From 1" Geology Survey map make up an enlargement of local area - say 6" to mile.
ratifications. Discuss hardness ography.	P	Examine specimens of local rock. See them in situ where possible.
ing order.	P	Simple experiments on hardness.
ssed polarised light for more ve demonstration (local museum p here).	D	Examine thin sections under the microprojector, especially of crystalline rocks, if available.
rips to show formation of rocks.	P	Crystallise a melt (Salol) under the microprojector or microscope.
ake regions - connection with n building.	P	Examine faulted ground correlate with map.
iscussion.	P	Point out areas where rocks do not surface - Glacial drift - boulder clay, sands.
on of glacial drift. Work of nd ice in landscaping, Films, ds etc., Climbing accidents.		
for different rates of growth, eas of high and low fertility - other than under-lying rock type.	P	Powder various local rocks. Grow radish seeds in each.

SYLLABUS	EXPLANATORY NOTES		
(3) Evolution	Discuss formation	P	From m
		P	Examin
		P	Examin
	Imprint and replacement types and use plasticine and Plaster of Paris.	P	Synthe
	'Shell' geological clock.	P	Constr variou
	Survival of species. Extinction of groups. Dinosaurs. P.S. Series by Visual Publications Limited. Animal Conservation.		Examin for on advanc
		D	Radioa dating
(4) Geology and Local Industry		P	Visit of sub
		P	Visit tions
		P	Visit etc.,
		P	Visit needs

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
Discuss formation	P	From map note fossil bearing localities.
	P	Examine fossils in situ.
	P	Examine fossils in collection.
Imprint and replacement types and use plasticine and Plaster of Paris.	P	Synthesise fossils.
'Shell' geological clock.	P	Construct a time chart showing duration of various sorts of life on earch.
Survival of species. Extinction of groups. Dinosaurs. P.S. Series by Visual Publications Limited. Animal Conservation.		Examine various vertebrates suggest reasons for one type being regarded as more simple?/ advanced? than another.
	D	Radioactive materials - geiger counter dating technique.
	P	Visit local quarries, mines etc. - effects of subsidence etc.
	P	Visit building sites - note type of foundations being dug - origin of bricks or stone.
	P	Visit cement works, metal working industries etc., origins?
	P	Visit reservoirs - advantages of sites; needs of industry.

8. FUELS

N.B. In any work involving combustible gases or hydrocarbon fuels there is clearly some risk should spend some time talking about safety precautions before beginning this topic and during all of the work undertaken.

	SYLLABUS	EXPLANATORY NOTES		SUGGE
		Film "The Production of Oil" - Shell "As Old as the Hills" - PFB		
(1)	Fuels Oil, Coal, Gas. Brief history of how each was formed and where found.	Use charts from B.P. Grangemouth. Coal Board. Gas Board.		Compare sam
(2)	Oil Fractions from Crude Oil.	1 gallon + samples from the Schools Advisory Officer, B.P. Grangemouth N.F. 8mm Cassette - Ealing NCP 1 - 5.	D	Fractional paraffin, l
		Only burns if molecules have sufficient energy.	P	Flash Point
		Pupils suggest methods.	D	Rates of Ev compared.
		Glass beads dropped through each sample.	P	Viscosity (
	Combusion of Petrol/air mixture.	Treat as rapid expansion. Tin must be warmed.	D	Sparking pl spark gener
	Comparison of energy released on burning liquid fuels.	Spirit lamp heating equal quantities of water for same time and compare temperature rises.	P	Paraffin, m + cork and
		Relative cost of use of different fuels; see "Which" September 1964.		

8. FUELS

tible gases or hydrocarbon fuels there is clearly some risk of fire or explosion. Teachers ng about safety precautions before beginning this topic and should insist on their observance taken.

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
"The Production of Oil" - Shell ld as the Hills" - PFB		
arts from B.P. Grangemouth. Board. Gas Board.		Compare samples.
ion + samples from the Schools ory Officer, B.P. Grangemouth N.F. ssette - Ealing NCP 1 - 5.	D	Fractional Distillation showing petrol, paraffin, lubricating oil.
burns if molecules have sufficient y.	P	Flash Point light few drops on asbestos mat.
suggest methods.	D	Rates of Evaporation of different samples compared.
beads dropped through each sample.	P	Viscosity (Stickiness).
as rapid expansion. Tin must be d.	D	Sparking plug inside closed tin attached to spark generator.
t lamp heating equal quantities of for same time and compare tempera- ises.	P	Paraffin, methylated spirit oil. Ink bottle + cork and wick in metal tube.
ive cost of use of different fuels; Which" September 1964.		

SYLLABUS	EXPLANATORY NOTES	SUGGEST
(3) Air Pollution		D Filtering ai
Smokeless Fuel and Health. Exhaust gases etc.	Van de Graaf. "Chemistry Takes Shape" Book 2, Johnston and Morrison published by Heinemann.	D Electrostati particles.
	Filter paper and cotton wool give suitable filter.	D Smoking Machi cigarette sm

PLANATORY NOTES		SUGGESTED PRACTICAL WORK
	D	Filtering air.
. akes Shape" Book 2, Morrison published by	D	Electrostatic precipitation of smoke particles.
and cotton wool give ter.	D	Smoking Machine to show impurities in cigarette smoke.

9. DYES

SYLLABUS	EXPLANATORY NOTES	
(1) Natural Dyes	"The Use of Vegetable Dye for Beginners" V. Thurston, Dryad Press.	P
(a) Plan and animal extracts used as dyes for thousands of years, e.g. Indigo, Alizarin Tyrian Purple, Cochineal.	Dye not just a coloured substance. The pigment must attach itself to the material and be "fast" to washing, air and sunlight.	P
(b) Nature of Material.	Wool and silk (animal fibres - proteins) generally speaking easier to dye than cotton and linen (vegetable fibres - cellulose). Proteins have acidic and basic groups which can react with alkaline and acidic dyes resp. Revise neutralisation. Cellulose has no such groups and cannct therefore react in this way with dyestuff solutions.	P
(c) Mordants.		P
		P
	Most mordants are metal hydroxides. Gel adheres to the fibres and gel absorbs the dye. Cotton and linen usually require a mordant.	P

9. DYES

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
he Use of Vegetable Dye for Beginners" Thurston, Dryad Press.	P	The class should attempt to dye pieces of cloth using extracts of bark, nutshells, berries, flowers etc.
e not just a coloured substance. The gment must attach itself to the material d be "fast" to washing, air and sun-ght.	P	Experiments devised by pupils to test "fastness" of various dyes.
ol and silk (animal fibres - proteins) nerally speaking easier to dye than tton and linen (vegetable fibres - llulose). Proteins have acidic and sic groups which can react with kaline and acidic dyes resp. Revise utralisation. Cellulose has no such oups and cannot therefore react in this y with dyestuff solutions.	P	Compare effect of same dye on wool, silk, cotton and linen. (Use extracts obtained as above, or, alternatively, picric acid solution).
	P	Formation of Aluminium hydroxide gel by adding ammonia solution to alum solution.
	P	Repeat but add a few drops of Indian ink to alum solution before adding ammonia solution.
st mordants are metal hydroxides. Gel neres to the fibres and gel absorbs the e. Cotton and linen usually require a rdant.	P	Dip cotton cloth in alum solution, then in dil. ammonia solution and then immerse in Alizarin solution. Dip an untreated piece of cotton cloth into the Alizarin solution. Compare results.

SYLLABUS	EXPLANATORY NOTES		SUGG
	Mordant can also react chemically with the dye producing a "lake".	P	Make a fer by dipping solution, Dip the cl Compare re
(2) Mineral Dyes			
(a) Making insoluble substance by precipitation.	Compound formed by precipitation in these actions has come partly from one solute,	P	Precipitat hydroxides several me decomposit
(b) Chrome Yellow.	Yellow lead chromate pptd. directly into the fibres of the material.	P	Cloth dipp into potas several ti
Chrome Orange.	Colour changes to orange. Basic lead chromate formed.	P	Dip cloth into boili seconds.
(c) Iron Buff (Khaki)	Grey-Green Iron (II) pptd. into Fibres, then oxidised to rust brown Iron (III). On drying ferric oxide is left on the cloth.	P	Cloth dipp
	Prussian blue formed on cloth.	D	Dip cloth into dilut containing
(d) Ferric Tannate	Ferrous tannate (almost colourless) deposited on cloth. Oxidised to black ferric tannate.	P	Cloth dipp then into

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
nt can also react chemically with ye producing a "lake".	P	Make a ferrous hydroxide mordant on a cloth by dipping it first into ferrous sulphate solution, then into dil. ammonia solution. Dip the cloth into alizarin solution. Compare result with that above.
ound formed by precipitation in these ns has come partly from one solute,	P	Precipitation reactions in T.Ts. Make hydroxides, carbonates and chromates of several metals e.g. lead, silver by double decomposition.
w lead chromate pptd. directly into ibres of the material.	P	Cloth dipped in lead acetate solution, then into potassium dichromate solution. Repeat several times to deepen the colour.
r changes to orange. Basic lead ate formed.	P	Dip cloth dyed with chrome yellow and dried into boiling lime water for two-three seconds.
-Green Iron (II) pptd. into Fibres, oxidised to rust brown Iron (III). ying ferric oxide is left on the .	P	Cloth dipped into (1) Ferrous sulphate solution. (2) ammonia solution and (3) sodium hypochlorite solution e.g. "Domestos".
sian blue formed on cloth.	D	Dip cloth previously dyed with iron buff into dilute potassium ferrocyanide solution containing a few drops hydrochloric acid.
us tannate (almost colourless) ited on cloth. Oxidised to black c tannate.	P	Cloth dipped into ferrous sulphate solution then into strong tea. Expose to air to dry.

SYLLABUS		EXPLANATORY NOTES		SUGGESTED PRACT
(3) Coal Tar Dyes				
(a)	The Birth of and Industry	Accidental discovery of "mauve" by Perkin (1856) whilst attempting to synthesise quinine. Dye-stuffs industry founded. Today over 5,000 coal tar dyes known. Nowadays dyes available for all purposes of all shades and hues, more brilliant and more permanent than the vast majority of natural dyes.	P	Project on devel Visit to I.C.I. Grangemouth/Film Pigment" I.C.I. Curzon Street, L
(b)	Aniline Black	If aniline hydrochloride not available teacher should make a supply using conc. HC1 and aniline. Dissolve crystals formed in water. Oxidation to aniline black speeded up by action of heat and moisture.	D	Cotton cloth soa solution contain chlorate as oxid copper sulphate the cloth is sti steam turns black
(c)	Synthetic	How can the indigo be dissolved?	P	Allow pupils to indigo for thems
		For practical details consult "Chemistry Magic" K. Swezey (Kaye). Pale yellow solution of "Indigo White" formed.	P	Reduction to "In in alkaline "sol 50°C (water bath
		"Indigo White" oxidised by air to insoluble indigo. Precipitated in fibres of material.		Dip cloth into p white but when r turns blue. Dar and exposure.
(4) Household Dyes				A few of these c best methods of experiment using dyeing of a white ably an old one!)
				If interest is ma be extended by at the new man-made

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
l discovery of "mauve" by Perkin ilst attempting to synthesise Dye-stuffs industry founded. r 5,000 coal tar dyes known.	P	Project on development of Dyestuffs industry. Visit to I.C.I. Dyestuffs Division - Grangemouth/Film "The Discovery of a New Pigment" I.C.I. Film Library, Bolton House, Curzon Street, London, W.1.
dyes available for all purposes ades and hues, more brilliant permanent than the vast majority l dyes.		
e hydrochloride not available hould make a supply using conc. niline. Dissolve crystals water. Oxidation to aniline eded up by action of heat and	D	Cotton cloth soaked in aniline hydrochloride solution containing a little potassium chlorate as oxidising agent and a little copper sulphate as catalyst. On removal the cloth is still white but when held in steam turns black.
he indigo be dissolved?	P	Allow pupils to discover insolubility of indigo for themselves
ical details consult "Chemistry Swezey (Kaye). Pale yellow of "Indigo White" formed.	P	Reduction to "Indigo White". Brought about in alkaline "solution" sodium hydroxide at 50°C (water bath) by sodium hydrosulphite.
hite" oxidised by air to indigo. Precipitated in material.		Dip cloth into prepared solution. Stays white but when removed and exposed to air turns blue. Darken by repeated dipping and exposure.
		A few of these could be obtained and the best methods of using them found by experiment using pieces of cloth. The dyeing of a white blouse or shirt (preferably an old one!) could then be attempted.
		If interest is maintained the project could be extended by attempting to dye some of the new man-made fibres.

10. CORROSION

The rusting of iron and the burning of metals lead to a consideration of the general problem o
linking theme is the activity series but this should not be treated as a separate topic.

Some of this work may be carried out in conjunction with other departments, e.g. Technical and

	SYLLABUS	EXPLANATORY NOTES		SUGGESTED
(1)	The problem of corrosion - some metals corrode more readily than others.	Everyday examples of corrosion. Effect of atmosphere on metals e.g. Magnesium, iron, zinc, lead, copper, tin, aluminium.	P	Expose clean samp
	Effect of dilute acids on above metals.	No details of gases or salts produced.	P	Certain metals m acids.
(2)	What is the cause of corrosion?	Introduce by experiment showing that as air is removed water rises in tube. These experiments may be set up by different groups and results compared later.	P	Air and water ne water.
			P	Show that part o
	Experiments on rusting of iron.			
	Oxidation of metals.	Relative ease of burning. Do not use potassium, sodium and calcium. Oxygen is obtained from cylinder.	P/D	Burn metals in o
	Effect of metals in contact.	Dimple Tile Experiments, e.g. as in "Chemistry takes shape", Johnston and Morrison, publisher Heinemann.	P/D	Experiments on d another, e.g. Zi solution.
	Sacrificial corrosion.	Experiments as e.g. in "Chemistry takes Shape".	P	Experiments on m

10. CORROSION

ad to a consideration of the general problem of corrosion of metal. The
not be treated as a separate topic.

ion with other departments, e.g. Technical and Homecraft Departments.

TES		SUGGESTED PRACTICAL WORK
rosion.	P	Expose clean samples of these to weather.
metals e.g. ead, copper,		
alts produced.	P	Certain metals may be attacked by dilute acids.
showing that rises in tube. set up by	P	Air and water necessary. Effect of CO_2 in water.
ults compared	P	Show that part of air is used up.
. Do not use lcium. Oxygen r.	P/D	Burn metals in oxygen.
e.g. as in Johnston and emann.	P/D	Experiments on displacement of one metal by another, e.g. Zinc in copper sulphate solution.
Chemistry takes	P	Experiments on metals in contact with gels.

	SYLLABUS	EXPLANATORY NOTES		SUG
(3)	Prevention of corrosion.	Discuss briefly common example such as car frames, ships hulls, bridges, flashings, tinned cans, pots and pans.		
	Economic problem.			
	Plating (including galvanising)	Refer to other platings.	P	Experimen
		Discuss in relation to activity series.	P	Compare galvanis
	Protective coatings of oxide.	Booklet obtainable from Aluminium Development Corporation.	P	Experimen
	Painting		P	Compare different
	Greasing and oiling	Care of tools, machinery, domestic equipment.		
	Use of Silica gel.	Packing.		

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
iefly common example such as , ships hulls, bridges, . tinned cans, pots and pans.		
ther platings.	P	Experiments on copper plating.
relation to activity series.	P	Compare effectiveness of tin plating and galvanising.
tainable from Aluminium t Corporation.	P	Experiments on anodising.
	P	Compare different types of paint on different metals.
ols, machinery, domestic		

FRICTION (Clean dry surfaces are essential for all experiments in Friction.)

SYLLABUS	EXPLANATORY NOTES		
(1) Introduction		D	Sharp on b
(2) Factors Affecting Friction			
(a) Friction depends on types of surface	Blocks should have surfaces of wood, glass, metal, medium	P	Woode on f bala
	Qualitative treatment only.	D	Abov surf
(b) Force of friction depends on weight.	Qualitative W↑ F↑	P	Plac gula stea
(3) Making Use of Friction and Dangers Due to Lack of Friction.	Discuss abrasives, sand blasting of sparking plugs, giving buildings a face lift, grinding and polishing, danager of highly polished floors in hospitals, homes and workshops, danger of wood shavings, on polished wooden floors, mats on floors, icy roads.	S	Exam and car condi
(4) Reducing Friction			
(a) Why Reduce Friction?	Friction produces heat. Advantages of disc brakes and large brake drums may be discussed at this point.	P	Rub h
		P	Rub c

11. SURFACE SCIENCE

ial for all experiments in Friction.)

XPLANATORY NOTES		SUGGESTED PRACTICAL WORK
	D	Sharp push given to blocks of wood resting on bench top.
ld have surfaces of wood, glass, metal, medium grade sand paper, linoleum, arpet etc.	P	Wooden blocks with different surfaces placed on friction board and pulled by newton balance.
treatment only.	D	Above repeated with boards of different surfaces.
W↑ F↑	P	Place different weights on top of a rectangular block and find pull necessary for steady speed.
asives, sand blasting of ugs, giving buildings a face ing and polishing, danager olished floors in hospitals, orkshops, danger of wood polished wooden floors, mats cy roads.	S	Examine car and cycle brakes (good condition and worn), clutch plates, belt drive e.g. car fan belt, car and cycle tyres (good condition and worn).
oduces heat. Advantages of and large brake drums may be this point.	P	Rub hands together.
	P	Rub coin vigorously on bench.

SYLLABUS	EXPLANATORY NOTES		SUGGI
	Show welding of metal parts due to heat produced by friction. Need to reduce friction in moving parts of machinery.	P	Rub tungst
(b) Lubrication	Discuss Hovercraft etc. and applications in car, factory and home.	P	(a) Oil o (b) Air u (c) Graphi Find the p steady spe
(c) Bearings	Discuss why trolleys have wheels.	P	Find pull dowel rods.
		D	Blocks on
		P	Examine ny Examine ba Examine ro
SURFACE TENSION	Glass surfaces used in surface tension experiments should all be cleaned by chromic acid and adequate rinsing in distilled water before use and should		
(1) Adhesion	Other uses of adhesives. Wetting should be seen as an example of adhension. Adhesion due to attraction between particles of one substance and particles of other substance.	P	Show water contaminat
		D	Demonstrat cating oil.
(2) Reducing Adhesion	Use in baking industry, non-stick frying pans, mould release agents in metal castings, importance in surgery.		Silicones. film.

100

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
ing of metal parts due to heat y friction. Need to reduce n moving parts of machinery.	P	Rub tungsten steel tool lathe bits together.
vercraft etc. and applications ctory and home.	P	(a) Oil on metal/metal surface. (b) Air using balloon puck. (c) Graphite or talc on wood/wood surface. Find the pull necessary to move block at steady speed before and after lubrication.
y trolleys have wheels.	P	Find pull necessary for block moving over dowel rods.
	D	Blocks on polystyrene beads.
	P	Examine nylon bearings. Examine ball bearings. Examine roller bearings.

n surface tension experiments should all be cleaned by prolonged soaking in strong uate rinsing in distilled water before use and should not thereafter be handled.

of adhesives.	P	Show water adheres to glass but not to contaminated glass surface.
ould be seen as an example of	D	Demonstrate with glue, solder and lubricating oil.
ue to attraction between par- one substance and particles of stance.		
ing industry, non-stick frying d release agents in metal mportance in surgery.		Silicones. Demonstration or suitable film.

	SYLLABUS	EXPLANATORY NOTES		SUGGES
	(3) Cohesion	Cohesion due to attraction between particles of one substance.	D	Show mercury
			D	Examine and water.
		By revising water on contamination glass experiment it should be brought to pupils' notice that it is normally not a question of 'Adhesion OR Cohesion' but one of 'Adhesion AND Cohesion'.	D	Using strobe from a tap.
	(4) Surface Tension due to Cohesion.		P	Fill tumbler observe surf
		Refer to pond skater, water beetle, fly, fishing, etc.	P	Float needle
	(5) Reducing Surface Tension and Increasing Wetting Power.		P	Float needle drop of dete
			P	Run dry sulp (a) distille
			P	Place large linen and th
		Detergents act as wetting agents. Refer to laundry, dish washing, etc.	P	Simultaneous into (a) dis solution. W
	CAPILLARITY			
	(1) Show Capilarity due to Surface Tension.		P	Place identi water and in
	(2) Show Capillarity Depends on Bore of Tube.		P	Different bo

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
·sion due to attraction between ticles of one substance.	D	Show mercury does not adhere to glass.
revising water on contamination glass eriment it should be brought to pupils' ce that it is normally not a question 'Adhesion OR Cohesion' but one of esion AND Cohesion'.	D	Examine and discuss drops of mercury and water.
	D	Using strobe light, examine water dripping from a tap.
	P	Fill tumbler to capacity with water and observe surface.
r to pond skater, water beetle, fly, ning, etc.	P	Float needle, steel wool in water.
	P	Float needle, steel wool in water and add drop of detergent.
	P	Run dry sulphur into beaker containing (a) distilled water (b) detergent solution.
	P	Place large drop of water on a piece of linen and then add a drop of detergent.
rgents act as wetting agents. r to laundry, dish washing, etc.	P	Simultaneously drop small pieces of cotton into (a) distilled water (b) detergent solution. Watch which piece sinks first.
	P	Place identical capillary tubes in pure water and in detergent solution.
	P	Different bores of tube placed in water.

SYLLABUS	EXPLANATORY NOTES	SU
(3) Capillarity in Everyday Life.		P Dip corn
	Need for damp course in building.	D (a) Pla (b) "Wa of
		D Blackboa vaseline strates

XPLANATORY NOTES		SUGGESTED PRACTICAL WORK
	P	Dip corner of blotting paper in ink.
mp course in building.	D	(a) Place brick in shallow bath of water. (b) "Water glass" or Silicone treatment of brick to waterproof.
	D	Blackboard crayon in ink. Break; seal with vaseline, rejoin and reimmerse. Demonstrates damp course.

SYLLABUS	EXPLANATORY NOTES		
(1) Forming the Image			
Revision of pin-hole camera.	Revision of work on pin-hole camera. Holes of different sizes should be provided. Boxes should be coated matt-black inside.	P	Usin imag
		P	Note Use pape hole
Effect of lens.	Use 'frost' plate to find sharpness of focus.	P	Moun for
The simple camera.	Pupils open camera and use 'frost' plate to observe effects of iris etc. (Warn pupils to avoid putting fingers on the lens.)	P	Obse
		P	Obse
(2) Recording the Image			
Effect of light on silver salts.	Show that only where light strikes is the silver salt darkened.	D	Plac chlo Deve
The photographic plate; developing.	Clear glass plates coated with gelatin emulsion of silver chloride prepared in advance. /Recipe in appendix./	P	Expo and to l
	Exposure in pin-hole camer at night pointed to sky will show rotation effects. Discuss need for fixing. Discuss light-struck halide changing to Ag.		

12. PHOTOGRAPHIC SCIENCES

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
n of work on pin-hole camera. Holes rent sizes should be provided. hould be coated matt-black inside.	P	Using pin-hole camera note relation of image size to distance of hole from screen.
	P	Note relation of image clarity to hole size. Use 1 cm hole covered by paper. Prick paper with pin once then twice then enlarge hole.
st' plate to find sharpness of focus.	P	Mount lens in hole and select correct lens for size of camera.
pen camera and use 'frost' plate ve effects of iris etc. (Warn o avoid putting fingers on the	P	Observe effect of moving lens.
	P	Observe effect of opening aperture.
t only where light strikes is the alt darkened.	D	Place cut-out on suspension of silver chloride in gelatin on bottom of dish. Develop. [See appendix for recipes.]
ass plates coated with gelatin of silver chloride prepared in in appendix.]	P	Expose plate in pin-hole camera. Develop and wash. Note effect of further exposure to light.
in pin-hole camer at night to sky will show rotation effects. need for fixing. Discuss light- alide changing to Ag.		

SYLLABUS	EXPLANATORY NOTES		SUG
Sensitivity (Optional extra)	Show reaction of last experiment noted. Show great speed of sensitised commercial film. Note convenience of film.	P	Expose pla for same and compar /Pin-hole
Forming permanent image; fixing.	Fixer dissolves away unexposed silver halide. Forty per cent solution of sodium thiosulphate good enough at this stage.	P	Expose son this alon both spec
Combined developer/ fixer.	Use of single bath processing should be demonstrated. Only this process should be used for the rest of the course.	D	Process a a single /Recipe i
At this stage pupils should be allowed to use cameras and to produce their own negatives. The negatives will be needed for the next part of the course.			
The positive print.	Use process evolved for Nuffield by *Kodak. This will allow more pupils to perform at any one time. This is a unique experience for the pupil and each one should print his own negative.	P	Mount nega Make test print. D clean dis
(3) Exposure			
Aperture shutter speed and film speed. Relating the variables.	Set up still life. Vary shutter speed in hand from fast to very slow. Show camera shake. Very aperture with constant shutter. Use slow speeds on moving objects Bring out value of tripod.	P	Take same shutter s negatives.
		P	Use very cable rel hand-held
		P	Take same smallest
		P	Repeat us most suit

/*Footnote "Record Photography in the Classroom", from Kodak Ltd., Industrial/Professional London, W.C.2./

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
how reaction of last experiment noted. how great speed of sensitised commercial ilm. Note convenience of film.	P	Expose plate and piece of A.S.A. 125 film for same time in pin-hole camera. Develop and compare. /Pin-hole is equivalent to f.64-120./
ixer dissolves away unexposed silver alide. Forty per cent solution of odium thiosulphate good enough at this tage.	P	Expose some film to daylight. Develop this along with an unexposed piece. Fix both specimens and compare.
se of single bath processing should be emonstrated. Only this process should e used for the rest of the course.	D	Process an exposed film in the cassette in a single bath developer/fixer. /Recipe in appendix./

ld be allowed to use cameras and to produce their own negatives by single bath processing. or the next part of the course.

se process evolved for Nuffield by *Kodak. his will allow more pupils to perform at ny one time. This is a unique experience or the pupil and each one should print is own negative.	P	Mount negative and place in F.S. projector. Make test strip on *P.153 paper then make print. Develop, wash and fix in three clean dishes.
et up still life. Vary shutter speed n hand from fast to very slow. Show amera shake. Very aperture with constant hutter. Use slow speeds on moving objects ring out value of tripod.	P	Take same picture hand held and reduce shutter speed. Process and compare negatives.
	P	Use very slow shutter using tripod and cable release. Compare negative with hand-held one.
	P	Take same picture but vary aperture from smallest to largest. Process and compare.
	P	Repeat using different speed of film. Find most suitable exposure.

y in the Clas oom", from Kodak Ltd., Industrial/Professional Sales Division, Kingsway,

(4) Practice

The art department should be enlisted to help by setting exercises in composition or which will require much processing. A competition might be the conslusion to the course.

Note

This course has left many of the standard photographic skills untaught. It has merel ciples in the simplest way possible. The use of the enlarger and the variety of developer would form the work of an enthusiastic camera club. What has been provided will allow a b in making effective use of photography both as an interest in itself and as a tool in othe

An interesting alternative course is Kodak's 'Fundamentals of Photography', available

Kodak Ltd.,
Educational Service,
Victoria Road,
RUISLIP,
Middlesex.

EXPLANATORY NOTES | SUGGESTED PRACTICAL WORK

nt should be enlisted to help by setting exercises in composition or texture or form, or other topics
ch processing. A competition might be the conslusion to the course.

left many of the standard photographic skills untaught. It has merely tried to show the basic prin-
t way possible. The use of the enlarger and the variety of developers are among the many things which
f an enthusiastic camera club. What has been provided will allow a beginner to employ simple skills
se of photography both as an interest in itself and as a tool in other studies.

lternative course is Kodak's 'Fundamentals of Photography', available from:

Kodak Ltd.,
Educational Service,
Victoria Road,
RUISLIP,
Middlesex.

Appendix

1. Formula for gelatin emulsion of silver chloride.

   A. 7.5g sodium chloride in 200 ml water.

   B. 28g gelatin soaked in cold water until swollen; pour off excess water.

   C. 12.5g silver nitrate in 125 ml distilled water + 1 drop of wetting agent.

   Add solution A to solution B on a water bath and heat to at least 40°C stirring to mix thoroughly.

   In subdued or safe-lighting add solution C slowly stirring continuously.

   Allow to cool and store in total darkness.

   To use reheat to 38°C to melt.

Developers

1. An M.Q. borax developer for films and plates.

Metol	2g
Sodium sulphite (anhydrous)	100g
Hydroquinone	5g
Borax	2g
Water to make	1000ml

Use without dilution in dish or tank.

Development times (at 20°C)

Pan F	6½ min
F.P.3 or Pan X	8 min
H.P.3 or Plus X	10 min
H.P.5 or Tri.X	14 min

2. An M.Q. developer for prints and enlarging papers.

Metol	3g
Sodium sulphite (anhydrous)	50g
Hydroquinone	12g
Sodium carbonate (anhydrous)	60g
Potassium bromide	4g
Water to make	1000ml

Dilute 1 part with 3 parts water for working strength.

Develop for $1\frac{1}{2}$-2 minutes at 20°C.

3. A single bath developer/fixer

Sodium sulphite (anydrous)	50g
Hydroquinone	12g
Phenidone	1g
Sodium hydroxide	10g
Sodium thiosulphate	90g
Water to make	1000ml

Six minutes is a safe time for all speeds of film to develop to infinity. Agitate continuously give 15-20 turns every minute. Wash for 20 minutes.

rints and enlarging papers.

	3g
ous)	50g
	12g
rous)	60g
	4g
	1000ml

rts water for working strength.

s at 20°C.

fixer

us)	50g
	12g
	1g
	10g
	90g
	1000ml

me for all speeds of film to develop to infinity. Agitate continuously for first ½ minute then . Wash for 20 minutes.

13. OPTICS

Introduction

The Course is seen as a form of environmental study in which pupils find out the optical prop
e.g. mirrors, lenses, etc. which are often found at home and are in plentiful supply in their lab

Their discoveries may be developed mainly heuristically and linked closely with many Brunton
These links have been indicated where possible; others may be spotted by the teachers.

No mathematics has been attempted but some pupils may understand a little simple geometry en
constructions for mirrors and lenses.

A darkroom or a laboratory with blackout is desirable for photographic experimental work. Ca
minimise effects of stray light, which can usually be achieved by using strips of dark material ro

SYLLABUS	EXPLANATORY NOTES	SUGGESTE
(1) Ray Boxes		
Lamp, lens, shutter etc.		P Light travels i pencils, beams. diverging.)
		P Construct a pi box.
	S.S.S.E.R.C. model.	P Use pin-hole ca Develop negati
Point and extended Sources.	Brief discussion and demonstration.	D Study shadows. complete and pa
		Eclipses.
(2) Lenses	Principal focus, focal length and paths of main rays should be recognised.	P Investigate eff
Spherical lenses. Use in instruments.		P Use of half-len converging and

13. OPTICS

vironmental study in which pupils find out the optical properties of common items, ften found at home and are in plentiful supply in their laboratories.

d mainly heuristically and linked closely with many Brunton topics on the block diagram. possible; others may be spotted by the teachers.

but some pupils may understand a little simple geometry enough to undertake graphical

lackout is desirable for photographic experimental work. Care should be taken to can usually be achieved by using strips of dark material round each pupil's experiments.

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
	P	Light travels in straight lines; rays, pencils, beams. (Parallel, converging, diverging.)
	P	Construct a pin-hole camera e.g. from shoe-box.
.C. model	P	Use pin-hole camera to expose film. Develop negative.
ussion and demonstration.	D	Study shadows. Umbra, Penumbra. (Refer to complete and partial shadow.)
		Eclipses.
focus, focal length and paths ys should be recognised.	P	Investigate effect of lens shape.
	P	Use of half-lenses with ray box to obtain converging and diverging rays.

SYLLABUS		EXPLANATORY NOTES		SUGGESTED
			P	Study of spheri
(2)	(Contd.)	12V 24W car lamp source with white card screen.	P	Focussing of im luminous object
		Image size may be measured to get magnification if desired. That magnification depends on object/image distance and focal length of lenses used should be noticed by pupils.	P	Illuminate pers object) with la screen. Leads projector.
	Photographic Enlarger or Film Projector.		P	Construct model perspex scale, bulb, double co Focus sharpest brightness lead lens.
		Pupils bring favourite negative - project image on to screen then introduce contact paper and expose. Developed, rinsed, fixed in large trays on teacher's bench - use red filter and arrange raybox as safelight.	D	Use of enlarger produce photogr
	Telescope		P	Model telescope
	Microscope		P	Simple and comp
	Defects of Vision		D	Model eye as Ca
		Nuffield Model Eye.	P	Pupils set up r sight, short si

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
	P	Study of spherical lenses.
24W car lamp source with white card een.	P	Focussing of image of filament (self-luminous object) on screen.
e size may be measured to get magnifi-on if desired. That magnification nds on object/image distance and focal th of lenses used should be noticed upils.	P	Illuminate perspex ruler (illuminated object) with lamp and focus image on screen. Leads up to enlarger or film projector.
	P	Construct model enlarger or projector with perspex scale, illuminated by car lamp bulb, double convex lens and screen. Focus sharpest image. Variation of brightness leads to need for a condenser lens.
ils bring favourite negative - project e on to screen then introduce contact er and expose. Developed, rinsed, d in large trays on teacher's bench - red filter and arrange raybox as elight.	D	Use of enlarger or film strip projector to produce photographic print.
	P	Model telescope constructed.
	P	Simple and compound microscope constructed.
	D	Model eye as Camera
field Model Eye.	P	Pupils set up rayboxes to illustrate long sight, short sight and correction.

SYLLABUS	EXPLANATORY NOTES		SUGGESTED E
(3) Mirrors			
Plane mirror used with raybox.		P	Equal angle law o image.
	Retrovisor for cars.	P	Construct mirror
	Pupils get angle of deviation = 2 x angle of rotation - leads to the sextant.	*P	Study rotating mi
	Sailing, fishing.	*D	Use of sextant.
Spherical mirrors.	Use of plane and convex mirrors in cars. Concave mirrors in headlamps of cars.	P	Cyl. concave and Practical study o
(4) Prisms, etc.			
(a) Semicircular Blocks.	Refraction is merely bending of a ray towards normal for air-glass tra normal for glass-air path.		
		P	Show 'bending'.
	Leads to perspex rod as light guide. Reflection. Refraction. Trans-mission.	P	Total internal re
	Absorption noticed.	*P	Critical angle fo ment.
(b) Triangular Prism	Give use in prism binoculars. Submariner's periscope.	P	Total internal re prismatic perisco
		P	Study dispersion filters.
	Stage-Lighting effects.	D	Colour addition -

/Footnote * Optional Extra./

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
	P	Equal angle law of reflection. Note of image.
for cars.	P	Construct mirror periscope.
angle of deviation = 2 x otation - leads to the sextant.	*P	Study rotating mirror.
shing.	*D	Use of sextant.
e and convex mirrors in cars. rrors in headlamps of cars.	P	Cyl. concave and convex types with raybox. Practical study of spherical mirrors.
is merely bending of a ray towards normal for air-glass transmission and away from glass-air path.		
	P	Show 'bending'.
erspex rod as light guide. . Refraction. Trans-	P	Total internal reflection.
noticed.	*P	Critical angle for glass found by experiment.
n prism binoculars. 's periscope.	P	Total internal reflection. Construct prismatic periscope.
	P	Study dispersion and colour. Colour filters.
ting effects.	D	Colour addition - Subtraction.

SYLLABUS	EXPLANATORY NOTES		SUGGESTED
	Use of Cosmetics in Theatre and T.V.	P	Illuminate colo lights to get s reflection.
	Cutting Gemstones.		
	Aim is to show effect rather than cause.		
	Use photo transistor for I.R.) Use fluorescent paint for U.V.) with plastic prism.	P	Study of radiat detection of U.
	Crime Detection.		
	Eye catching paints in Advertising.		
	Electromagnetic Spectrum could be introduced, stating that radiations may be though of as waves.	D	Reflection, ref

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
Cosmetics in Theatre and T.V.	P	Illuminate coloured surfaces with coloured lights to get selective absorption and reflection.
Gemstones.		
to show effect rather than cause.		
to transistor for I.R.) orescent paint for U.V.) plastic prism.	P	Study of radiation outside range of visible - detection of U.V. and I.R.
etection.		
ching paints in Advertising.		
magnetic Spectrum could be intro- stating that radiations may be of as waves.	D	Reflection, refraction of I.R., U.V.

14. ASTRONOMY

SYLLABUS	EXPLANATORY NOTES		SUGGESTED
(1) The Earth			
(a) Its place in the Universe.		P	Project on plane
Scale for size and distance.			
(b) Movements of the earth.	Cause of seasonal variations, e.g. Season of winter - effects on life on earth - leaf fall, seed production, migration, hibernation, camouflage, etc.	D	Globe and projec revolution and t
Day and night. The seasons.			
(c) Dependance on Sun.	OCP71 detector to show energy outwith visible spectrum.	P	Use prism.
		D	Globe and projec
Energy forms received.		P	Toy globes and b
Eclipses (a) of sun (b) of moon.			
(2) The Moon			
Latest information from Lunar satellites.	Class collection of photographs. Show Lunar Atlas.	P	Project on biolo visit to moon.
The Tides	Study tide tables for nearest Resort/Port. Notice effect at Equinox. Log position of observed moon in relation to high tides.	D	Model showing ef and moon giving
(3) Satellites		P	Use "Guardian" C satellites.

14. ASTRONOMY

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
	P	Project on planet sizes.
ause of seasonal variations, e.g. Season f winter - effects on life on earth - eaf fall, seed production, migration, ibernation, camouflage, etc.	D	Globe and projector effects of rotation, revolution and tilt of axis.
CP71 detector to show energy outwith isible spectrum.	P	Use prism.
	D	Globe and projector.
	P	Toy globes and balls.
lass collection of photographs. how Lunar Atlas.	P	Project on biological requirements for visit to moon.
tudy tide tables for nearest Resort/Port. otice effect at Equinox. Log position f observed moon in relation to high tides.	D	Model showing effects of pulls from sun and moon giving Neap and Spring tides.
	P	Use "Guardian" Chart to spot visible satellites.

SYLLABUS	EXPLANATORY NOTES	SUGGESTED
(4) Stars		
Main stars and constellations used in navigation.	"I Spy the Sky" Film strips useful.	P Make star chart, rear.

For experimental work on making an optical telescope and the use of photography in astonomy re

Possibility of visits to Observatories should be investigated locally.

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
he Sky" Film strips useful.	P	Make star chart, perforate, project from rear.

an optical telescope and the use of photography in astonomy refer to "Optics".

tories should be investigated locally.

15. WEATHER SCIENCE

SYLLABUS	EXPLANATORY NOTES		SUGGESTED
(1) Air Pressure			
Air has weight.	Round bottom flask or ball from ball-cock.	D	Weigh container pumped in.
Air pressure in all directions.		D	Evacuate can.
		D	Magdeburg hemisp
	Show also mouth down in water trough.	C	A.P. supporting
(2) Barometers			
Water Barometer	Glass tubing joined in sections.	D	In stair-well o
Hg Barometer		D	Produce Hg baron
Aneroid Barometer.	Also show Barograph, if available.	P	Model with powde
		D	Altimeter
(3) Weather			
Weather map.	Link with TV map or newspaper forecast. Direction and speed of air mass diagnosed.	D	Make with magnet map, iron sheet.
			Isobars, Anticyc
	Set out in sequence.	P	Old synoptic cha
Humidity	Compare with solubility.	D	Direct Reading H
	Include smoke.		Radiosondes.

15. WEATHER SCIENCE

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
ottom flask or ball from ball-cock.	D	Weigh container 'empty' and with extra air pumped in.
	D	Evacuate can.
	D	Magdeburg hemispheres.
so mouth down in water trough.	C	A.P. supporting water in inverted jar.
ubing joined in sections.	D	In stair-well of school.
	D	Produce Hg barometer.
ow Barograph, if available.	P	Model with powder puff box, spring, lever.
	D	Altimeter
th TV map or newspaper forecast. on and speed of air mass diagnosed.	D	Make with magnetic rubber strip, plastic map, iron sheet.
		Isobars, Anticyclones, Depressions.
in sequence.	P	Old synoptic charts. (Met. Office.)
with solubility.	D	Direct Reading Hygrometer.
smoke.		Radiosondes.

SYLLABUS	EXPLANATORY NOTES		SUGGESTE
Cloud formation.	Nuclei.	D	Pump air into to expand.
	Ford Picture chart Films filmstrips.	D	Main types of
Sunshine recorder.	S.S.S.E.R.C. List.	D	
Fronts.	Recognition of approach of front systems.	P	Revise effect
			Make hot air b 24 swg. wire,
Thunder and Lightning.	330m per second.	D	Revise Section sound - whistl
Climate.	Link with Geography department.		Movement and c Maritime, Pola

Project. Class weather record of pressure, temperature, humidity, rainfall, wind strength and di be left throughout; collect range of results each session. Compare forecasts with actual weather "Setting up a School Weather Station".)

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
.	D	Pump air into damp Winchester, then allow to expand.
icture chart Films filmstrips.	D	Main types of cloud.
E.R.C. List.	D	
ition of approach of front systems.	P	Revise effect of temperature on gas.
		Make hot air balloon - tissue paper and 24 swg. wire, or thin polythene bag.
r second.	D	Revise Section 7 (Electrostatics). Speed of sound - whistle and flag method.
ith Geography department.		Movement and characteristics of air masses, Maritime, Polar continental etc.

ressure, temperature, humidity, rainfall, wind strength and direction, visibility to
f results each session. Compare forecasts with actual weather record. (Film strip -
n".)

16. FLOW

SYLLABUS	EXPLANATORY NOTES		SUGGESTED
(1) Pressure			
Variation of pressure with force and area.	'Stools' made from blocks. If required quantitatively use metric units. Reference to stilleto heels.	P	Wooden 'stools' placed on plast laid on them.
Air exerts pressure.	See 'Weather' A.P. experiments.	S	Air pressure ex fashion.
Pressure gauge.		S	Simple 'Bourdon novelty.
		S	Bourdon Gauge.
Squeezing gases.		S	Disposable 20 m close end with Pull plunger.
Liquid pressure.		S	Bourdon gauge c PVC tubing with
(2) Flow		S	Football bladde tubing after bl
		S	Detergent bottl cutting off the water.
Bernoulli	See Rogers "Physics" for the Inquiring Mind" chapter IX, publisher, Oxford. Jardine's "Physics is Fun" II, P.9 Fig. 17, publisher Heinemann.	D	Bernoulli effect

16. FLOW

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
ools' made from blocks.	P	Wooden 'stools' of different X-section placed on plasticene and various loads laid on them.
required quantitatively use metric units.		
erence to stilleto heels.		
'Weather' A.P. experiments.	S	Air pressure experiments done in 'stations' fashion.
	S	Simple 'Bourdon' gauge made from party novelty.
	S	Bourdon Gauge.
	S	Disposable 20 ml syringe set at 10 ml - close end with finger then push pluger. Pull plunger.
	S	Bourdon gauge connected to tube then fill PVC tubing with liquid to different depths.
	S	Football bladders or balloons connected by tubing after blowing up one.
	S	Detergent bottles connected by tubing after cutting off their bases. Fill one with water.
Rogers "Physics" for the Inquiring d" chapter IX, publisher, Oxford.	D	Bernoulli effect pressure gradient apparatus.
dine's "Physics is Fun" II, P.9 . 17, publisher Heinemann.		

SYLLABUS	EXPLANATORY NOTES		SUGGESTEI
	"Physics is Fun" II P.9 Fig. 16.	D	Bernoulli effe
	"Physics is Fun" II PP. 10-14.	S	Other Bernoulli fashion.
	"Physics is Fun" II P.9 Fig. 18.	D	Multi-manometer
		D	Carburettor or
		D	Lift on wings.
Streamlining and turbulent flow.	"Physics is Fun" II P.2 Fig. 1.	D	Difference betw flow.
	Edinburgh Smoke Tunnel.	D	Flow round obst
(3) Hydraulics			
Incompressibility of liquids.	'Soft' car-brakes (air bubble in syringe with water).	P	20 ml syringe h over end then s
Transfer of forces.	Use polythene tubing since rubber stretches and glue it on with Araldite.	P	Two syringes con system with wat
	Elicit this idea from the pupils?	P	Try effect of d and different f
Hydraulic systems.	Energy conversion kit pump.	D	Principles of i
	(No force pumps or lift pumps).		

LANATORY NOTES		SUGGESTED PRACTICAL WORK
un" II P.9 Fig. 16.	D	Bernoulli effect velocity apparatus.
un" II PP. 10-14.	S	Other Bernoulli experiments 'stations' fashion.
un" II P.9 Fig. 18.	D	Multi-manometer.
	D	Carburettor or similar.
	D	Lift on wings.
un" II P.2 Fig. 1.	D	Difference between streamline and turbulent flow.
ke Tunnel.	D	Flow round obstacles.
akes (air bubble in syringe	P	20 ml syringe half full of water. Finger over end then squeeze and pull.
tubing since rubber glue it on with Araldite.	P	Two syringes connected by tubing. Fill system with water then move one piston.
dea from the pupils?	P	Try effect of different sizes of syringe and different forces.
sion kit pump.	D	Principles of impeller pump.
ps or lift pumps).		

17. ELECTRIC CIRCUITS

SYLLABUS	EXPLANATORY NOTES		SUG
(1) Resistance	Constant found is determined by "/" and is called 'resistance'.	P	Series circui nichrome wire accumulators
Ohm's law			
(a) Effect of "1"			Keeping "1" c
	Rule $\frac{V}{I} = R$		Table of valu
	Find R α 1	P	Repeat with $\frac{1}{2}$
(b) Effect of area.	Show A ↓ R ↑		Repeat using
(c) Effect of temperature	Show T ↑ R ↑	D	Heat iron wir
	Give idea of current surge when supply first switched on.	P	Replace iron Find 'cold re
			Compare with calculated fr
			$R = \frac{V}{I} = \frac{12}{2}$
		P	Build m/c met
(2) Measuring Instruments			
Moving Coil Meter	Quantitive examples where desirable - otherwise qualitative approach.	D	Demonstration resistors to ammeter or vo
		D	Hot wire and form, if avai

17. ELECTRIC CIRCUITS

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
nt found is determined by "/" and lled 'resistance'.	P	Series circuit of about 10 to 25 cm 32 swg nichrome wire,)-2A ammeter, 1 to 4 accumulators (or Lab Pack 0-8V).
		Keeping "1" constant, vary V.
$\frac{V}{I}$ = R		Table of values of $\frac{V}{I}$ gives constant.
I α 1	P	Repeat with $\frac{1}{2}$, 2 1 etc.
A ↓ R ↑		Repeat using another gauge.
I ↑ R ↑	D	Heat iron wire in Bunsen flame.
dea of current surge when supply switched on.	P	Replace iron wire by car headlamp 24W, 12V. Find 'cold resistance' on 12V.
		Compare with value when hot, in use, calculated from $R = \frac{V}{I} = \frac{12V}{2A} = 6\ \Omega$
	P	Build m/c meter model using Westminster kit.
itive examples where desirable - wise qualitative approach.	D	Demonstration meter with shunts and series resistors to give different ranges as ammeter or voltmeter.
	D	Hot wire and moving-iron meters - in model form, if available.

SYLLABUS		EXPLANATORY NOTES		SUGGESTED P
(3)	Car Electrics	This should be done by using the 'stations' technique. Components brou should be available for wiring alongside the appropriate apparatus encl Each circuit should be wired using a separate colour of wire for recogn comparing with the same circuit in the composite model assembled from t should be maintained assembled on a dexion frame.		
	(a) Horn	Electromagnet idea. Horn is like electric bell.	S	Wire up horn (or tr
	(b) Petrol Gauge	Position of float adjusts R value. Gauge is an ammeter.		Wire up rheostat,
	(c) Induction coil	Transformer action, conversion of d.c. to a.c. by 'points'. Show cut-away coil.	S	Assemble distribu etc.
	(d) Starter motor	0-100A Ammeter useful if available.	D	Show initial curr 80A.
	Wiper motor			
	(e) Dynamo	Many energy conversion sequences afforded.	S	Examine dynamo in
	(f) Lights		S	Wire up head-lamp Find current in e
	(g) Flashers	Current for correct flashing to be adjusted accurately.		Revise bimetal
			S	Wire up flasher c
	(h) Car Battery	Pupils take turns of wiring up accs. on battery charger.	D	'Form' lead plate through bulb.
			S	Examine accumulat Acid S.G. (as a n Recharging and to

NOTES		SUGGESTED PRACTICAL WORK
y using the 'stations' technique. Components brought from car scrapyards or wiring alongside the appropriate apparatus encountered in section 15. e wired using a separate colour of wire for recognition purposes when me circuit in the composite model assembled from the "Lucas Car Kit" which ssembled on a dexion frame.		
orn is like electric bell.	S	Wire up horn (or trafficator), switch and labpack.
ts R value. Gauge		Wire up rheostat, ammeter, etc.
nversion of d.c. to w cut-away coil.	S	Assemble distributor and drive, coil, plug, etc.
if available.	D	Show initial current when starting is about 80A.
n sequences afforded.	S	Examine dynamo in parts.
	S	Wire up head-lamp, side-lamps in parallel. Find current in each branch.
lashing to be adjusted		Revise bimetal strip idea.
	S	Wire up flasher circuit.
iring up accs. on	D	'Form' lead plates in a car discharge through bulb.
	S	Examine accumulator. Measure e.m.f., Acid S.G. (as a number only). Maintenance - Recharging and topping up.

	SYLLABUS	EXPLANATORY NOTES		SUGGESTED
(4)	Alternating Current			
	A.C.	Visit nearest Power Station.	D	Examine outputs (a) slipri (b) split
			P	Examine output f without rectifie
			D	Examine power pa
	National Grid	Advantage - economy. Disadvantage - insulation. Considering transformers as 100% efficient, calculate currents in cables at varying voltages.	P	Construct transf kit C-Cores.
(5)	Domestic Electricity			
	House Wiring	Revise Section 7.7		
		Advantage of ring system.	P	Model of wiring mains switch, fu
		Re-emphasise safety devices.	P	Two-way switches
		Homecraft Department for actual use.	S	Re-examine 'cut-
	Electrical Bills	Examination of Electricity bills and realism.	P	Rule, power (kW) from section 15
			P	Reading the mete
	Lighting	Show examples available.	D	History of devel
				Carbon arc. Car filament. Fluor

Possible further developments are indicated in the syllabus of the Electrical Association for

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
Visit nearest Power Station.	D	Examine outputs on C.R.O. from armature (a) sliprings (b) split rings.
	P	Examine output from LV Power Pack with/ without rectifier in series.
	D	Examine power pack construction.
Advantage - economy. Disadvantage - insulation. Considering transformers as 100% efficient, calculate currents in cables at varying voltages.	P	Construct transformers using Westminster kit C-Cores.
Revise Section 7.7		
Advantage of ring system.	P	Model of wiring layout using meter, mains switch, fuse boxes, lamps, elements.
Re-emphasise safety devices.	P	Two-way switches.
Homecraft Department for actual use.	S	Re-examine 'cut-away' electrical appliances.
Examination of Electricity bills and realism.	P	Rule, power (kW) x time (h). Use table from section 15 to calculate costs.
	P	Reading the meter.
Show examples available.	D	History of development. Carbon arc. Carbon filament. Tungsten filament. Fluorescent types.

ments are indicated in the syllabus of the Electrical Association for Women.

18. ELECTRONICS

The topic 'Electric circuits' should be covered first.

The purpose of this topic is to provide an understanding of radio reception.

SYLLABUS	EXPLANATORY NOTES		SUGGESTED PR
(1) Introduction	Revise Ohm's Law (see 'Electric Circuits')	P	Dismantle old sets
(2) Resistors and their uses			
(i) Examination Colour code.	Symbol. Display colour code. Explain use and 'preferred' values. Tolerances - w/w types have value printed. Classification of components.	P	Radio carbon types
(ii) Voltage division by resistors.	Use radio types.	P	Two resistors in s across each.
(iii) Variable voltage.	Give symbol. Use e.g. 1K Ω w/w 3 watt radio types. Open to show action.	P	Measure voltage fr slider is moved.
(iv) Rheostats.	Use linear type.	P	100 ohm pot. in se 10-25 ohm with 3V.
(3) Capacitors and their uses.			
(i) Construction and types	Give symbols. Open a block-paper type to show construction. Emphasise polarity of electrolytics. Draw attention to the units marked on them.	D	Various types incl
(ii) Storage of charge.		S	Charge 10,000 uF 6 6V bulb.

18. ELECTRONICS

hould be covered first.

provide an understanding of radio reception.

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
Ohm's Law (see 'Electric Circuits')	P	Dismantle old sets.
. Display colour code. Explain 1 'preferred' values. Tolerances - es have value printed.	P	Radio carbon types; $\frac{1}{4}$, $\frac{1}{2}$, 1 watt types.
fication of components.		
dio types.	P	Two resistors in series. Measure voltages across each.
mbol. Use e.g. 1K Ω w/w 3 watt ypes. Open to show action.	P	Measure voltage from slider to one end as slider is moved.
ear type.	P	100 ohm pot. in series with 6V bulb, or 10-25 ohm with 3V.
mbols. Open a block-paper show construction. Emphasise y of electrolytics. Draw on to the units marked on them.	D	Various types including air-spaced variable.
	S	Charge 10,000 uF 6V electrolytic through 6V bulb.

SYLLABUS		EXPLANATORY NOTES		SUGGESTED
			S	Charge capacito dry battery and microampere met
			S	Lift 20g wt usi 5000 uF Capacit
(iii)	Photoflash	Flash Photography	S	15V charging 25 Switch and phot capacitor.
(iv)	Electronic	Demonstrate use as external time-base for C.R.O.	D	1kΩ resistor, I series with var 250V DC supply.
(v)	AC on capacitors.	Use 0.1, 1, 4 and 8 uF block paper types.	S	Audio oscillato series with 6V capacitor. Wor lights. or 'White' V.L.F. meter (10mA) wi capacitor.
(4)	Inductors and their uses.			
(i)	DC on inductors	Core in and out (Westminster 'C' cores).	S	DC to Unilab L/
(ii)	AC on inductors		S	Audio oscillato coil (Unilab) w up from 15 Hz. or 'White' V.L.F. with Unilab coi

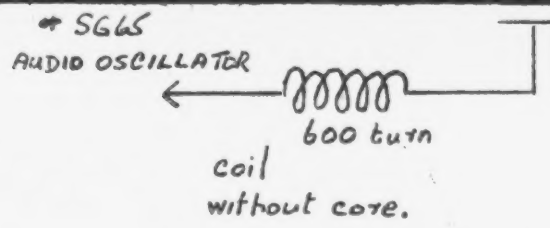
EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
	S	Charge capacitors from 1 to 4 uF from $1\frac{1}{2}$V dry battery and discharge through a 50 microampere meter.
	S	Lift 20g wt using electric motor & 25 volt 5000 uF Capacitor.
Photography	S	15V charging 250 uF through 3.3k resistor. Switch and photoflash bulb in series across capacitor.
trate use as external time- or C.R.O.	D	1kΩ resistor, ImΩ rheostat (linear pot) in series with various capacitors fed from 250V DC supply. 110V neon across capacitor.
1, 1, 4 and 8 uF block paper	S	Audio oscillator low impedance output in series with 6V bulb and several values of capacitor. Work up from 15 Hz till bulb lights. or 'White' V.L.F. hand-wound generator and meter (10mA) with 50 uF electrolytic capacitor.
n and out (Westminster 'C'	S	DC to Unilab L/B coil & core, via 6V bulb.
	S	Audio oscillator output fed via 6V bulb to coil (Unilab) with cores in and out. Work up from 15 Hz. or 'White' V.L.F. generator and meter (10mA) with Unilab coil and core (5000 turn).

SYLLABUS	EXPLANATORY NOTES		SUGGESTED
(5) Semi-conductor diode			
(i) Diode in DC circuit	Use low voltage type e.g. OA81. Show high voltage high power type e.g. BY100.	S	$4\frac{1}{2}$V dry battery Reverse polarit
(ii) Diode in AC		S	L.V. a.c. to di Connect oscillo
(6) AC to DC			
(i) Capacitor smoothing	Open up L/V power pack to show rectifier and capacitor smoothing.	S	Try various val (load). Use os
(7) Tuned Circuit			
Series resonance	Acceptor circuit. Try different values of L and C, and relate to audio output.	S	See diagram 1.
(8) Radiowaves			
(i) Nature of radiowaves	Diagram 2 (transistorised R.F. oscillator).	D	Modulated RF os receiver. Vary
(ii) Rectification or detection by diode		P/D	Connect earphon R.F. outputs. with earphone a oscilloscope re
(9) Radio reception	Instruct in soldering using resin cored solder.	P	Details and cir
(i) Construction of M/W band RX			

EXPLANATORY NOTES		SUGGESTED PRACTICAL WORK
e low voltage type e.g. OA81. Show gh voltage high power type e.g. BY100.	S	$4\frac{1}{2}$V dry battery bulb and diode in series. Reverse polarity.
	S	L.V. a.c. to diode and bulb in series. Connect oscilloscope across load.
en up L/V power pack to show rectifier d capacitor smoothing.	S	Try various values of C connected across (load). Use oscilloscope.
ceptor circuit. Try different values f L and C, and relate to audio output.	S	See diagram 1.
agram 2 (transistorised R.F. oscillator).	D	Modulated RF oscillator. Tune in on a receiver. Vary A.F. and R.F.
	P/D	Connect earphone directly to the A.F. and R.F. outputs. Now insert diode in series with earphone and repeat. Repeat but with oscilloscope replacing earphone.
struct in soldering using resin red solder.	P	Details and circuit see diagram 3.

SYLLABUS		EXPLANATORY NOTES		SUGGESTED
(10) Transistors				
(i)	Structure and appearance.	Give symbol.	D	Open a transist base and collec
(ii)	Action		S	See diagram 4.
			S	See diagram 5.
(iii)	Current amplification.		S	See diagram 6,
(iv)	Heat sensitivity.	Precaution when soldering into circuits. Use pliers as heat sink.	S	See diagram 8. Heat water to 6
(v)	Photo-transistor.	Light meters.	S	See diagram 9. Expose to room light. Explore produced from p removed. Detec of wire gauze a
(ii) Crystal receiver with one transistor amplifier.				
(i)	Construction	The transistor is acting as a d.c. amplifier.	P	See diagram 10.
(12) Two-transistor amplifier.				
(i)	Construction	These amplifiers can follow the diode in the crystal receiver.	P	R-C coupled ampl 12 and 13.
			P	Pairs of these a telephones.

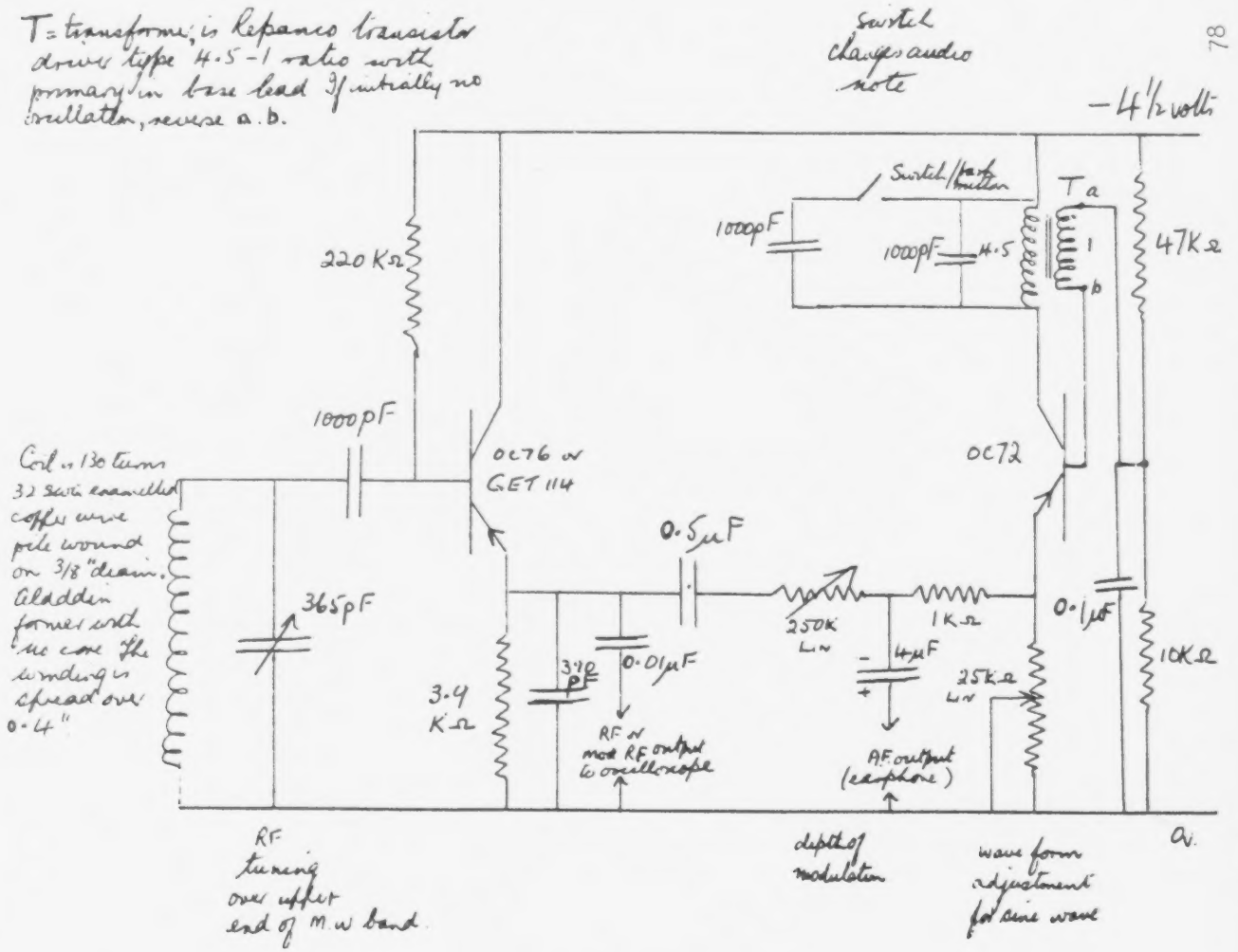
NATORY NOTES		SUGGESTED PRACTICAL WORK
	D	Open a transistor model to display emitter base and collector.
	S	See diagram 4.
	S	See diagram 5.
	S	See diagram 6, 7.
soldering into circuits. eat sink.	S	See diagram 8. Heat water to 60°C only.
	S	See diagram 9. Expose to room light, lit match, electric light. Explore spectrum of white light produced from projector with heat filter removed. Detect infra-red. Warm bundle of wire gauze and hold near photo-transistor.
is acting as a d.c.	P	See diagram 10.
s can follow the diode receiver.	P	R-C coupled amplifiers. See diagrams 11, 12 and 13.
	P	Pairs of these amplifiers used as two-way telephones.



RESONANT $f \approx 1{,}100$ c/ps
and is audible.

DIAGRAM 2

R. F. OSCILLATOR.



RE 41111 TBL

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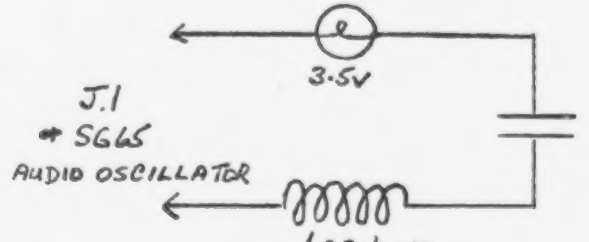
DIAGRAM 1.

SERIES RESONANCE
(ACCEPTOR)



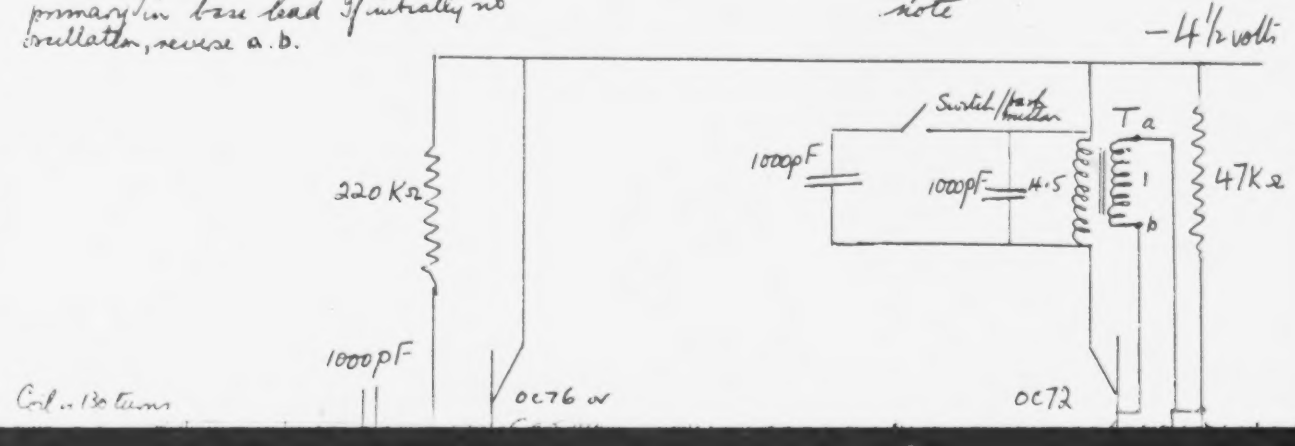
RESONANT $f \approx 1{,}100$ c/ps
and is audible.

DIAGRAM 2

R. F. OSCILLATOR.

T = transformer is Repanco transistor drivers type 4·5–1 ratio with primary in base lead if initially no oscillation, reverse a.b.

Switch changes audio note



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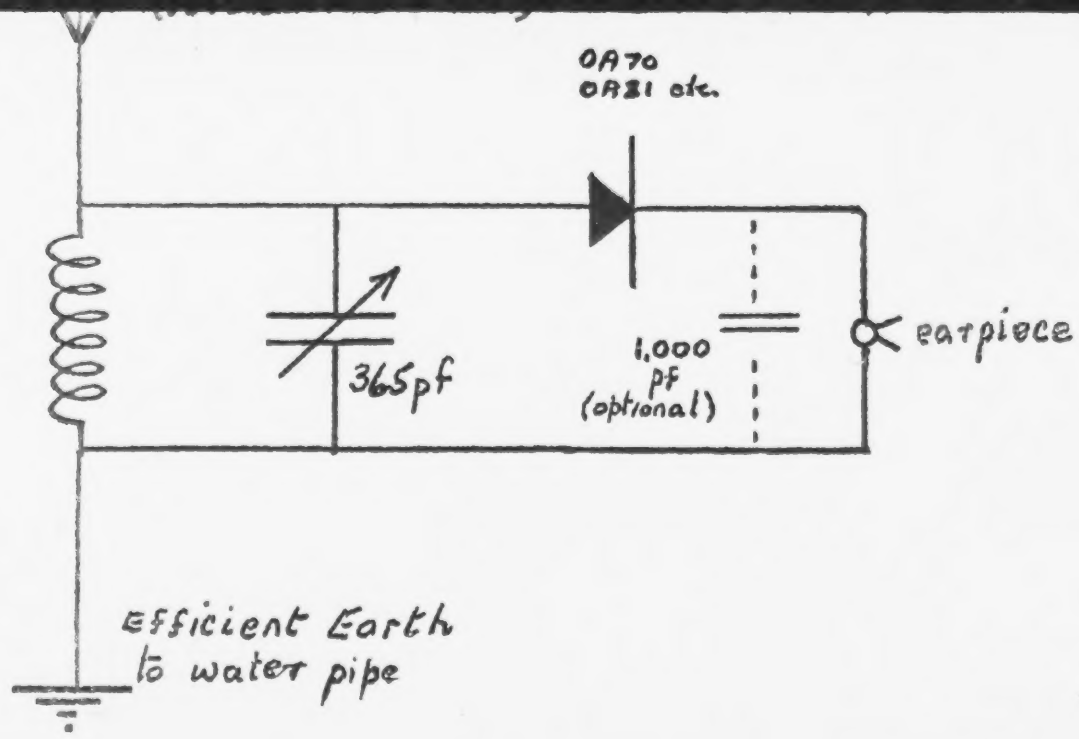

Details of Coil. Wind 60 turns of 24swg D.C.C. copper wire on 1½" cardboard tube former. Close wound. Tunes entire medium wave band. Can be assembled on piece of hardboard size of postcard.

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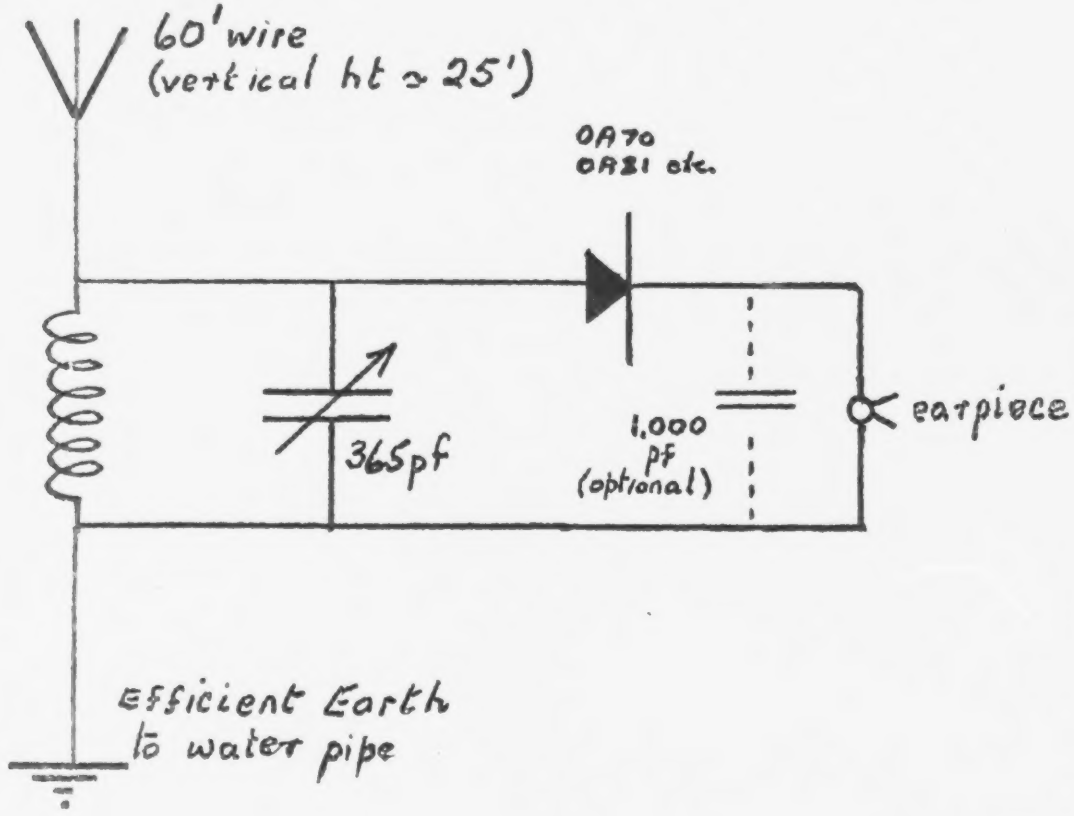
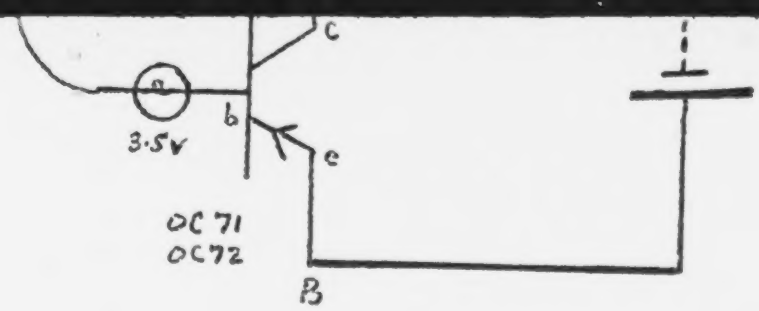
DIAGRAM 3.

CRYSTAL DIODE RECEIVER.



Details of Coil. Wind 60 turns of 24 swg D.C.C. copper wire on 1½" cardboard tube former. Close wound. Tunes entire medium wave band. Can be assembled on piece of hardboard size of postcard.

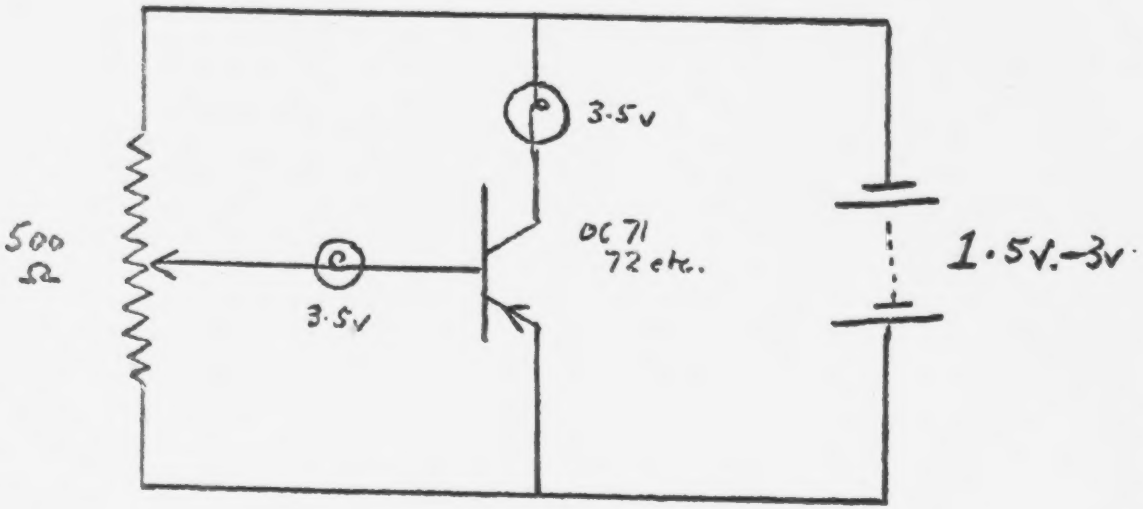


Notes (1) Plug base wander lead into A, collector bulb lights.

(2) " " " " " B, " " does not light.

(3) Now proceed to diagram 5.

DIAGRAM. 5.



Note:-

Vary voltage applied to base by potentiometer, observe effect on collector bulb. Gives working point.

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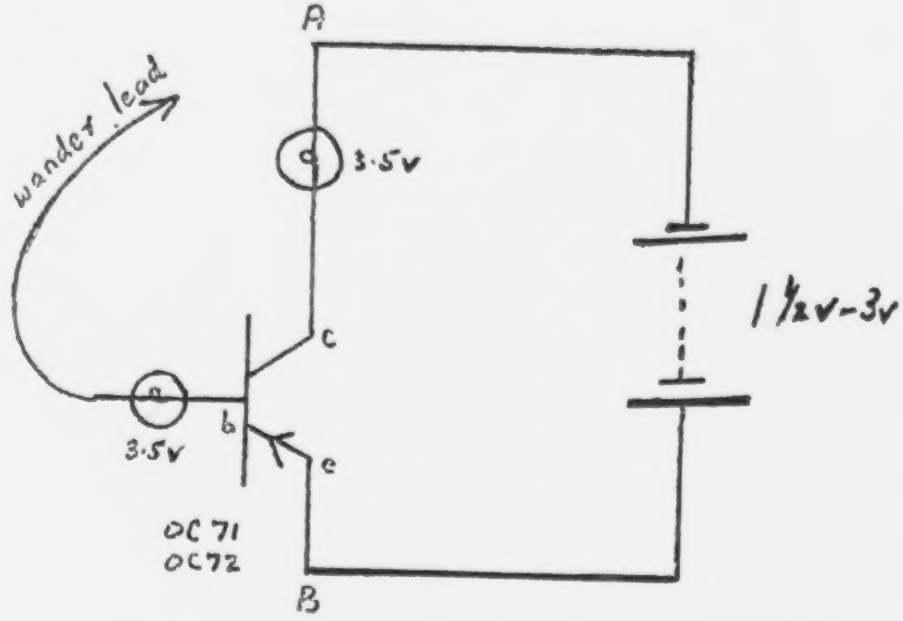
DIAGRAM 4.

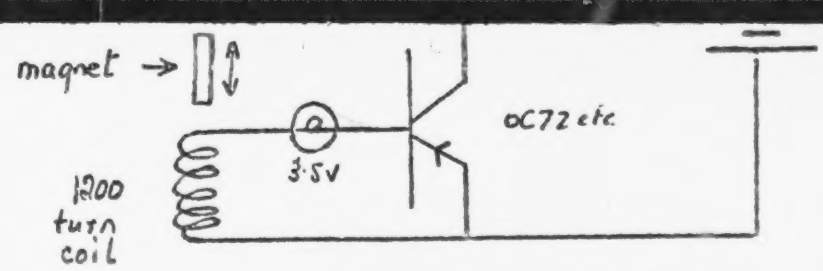


Notes (1) Plug base wander lead into A, collector bulb lights.

(2) " " " " " B, " " does not light.

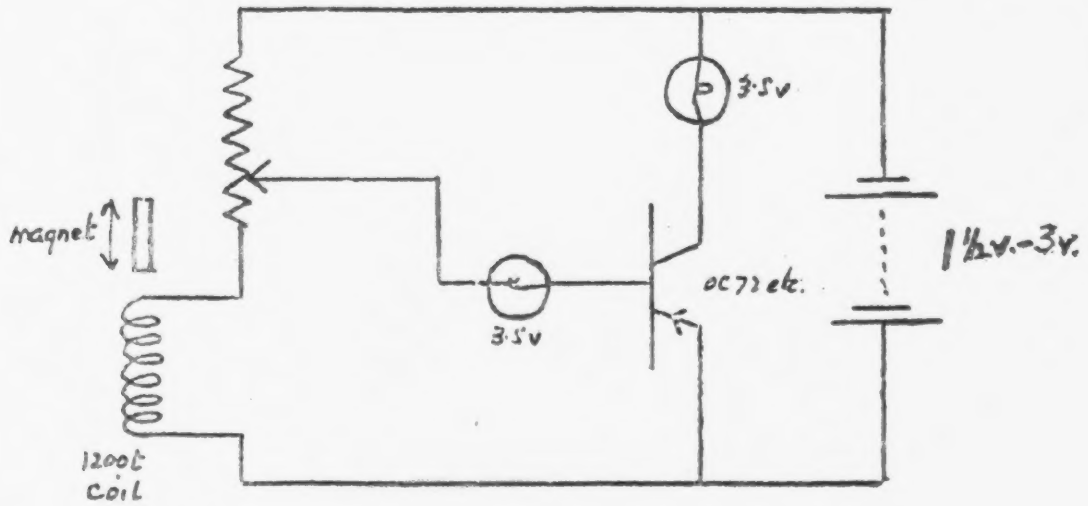
(3) Now proceed to diagram 5.

DIAGRAM. 5.



Note:- Move magnet in and out of coil.

DIAGRAM. 7.



Note:- Adjust potentiometer to working point, move magnet in and out.

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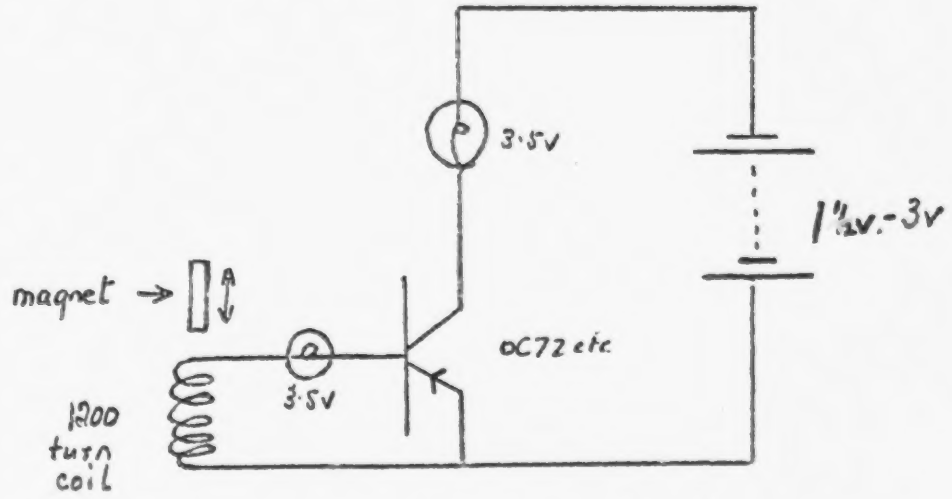
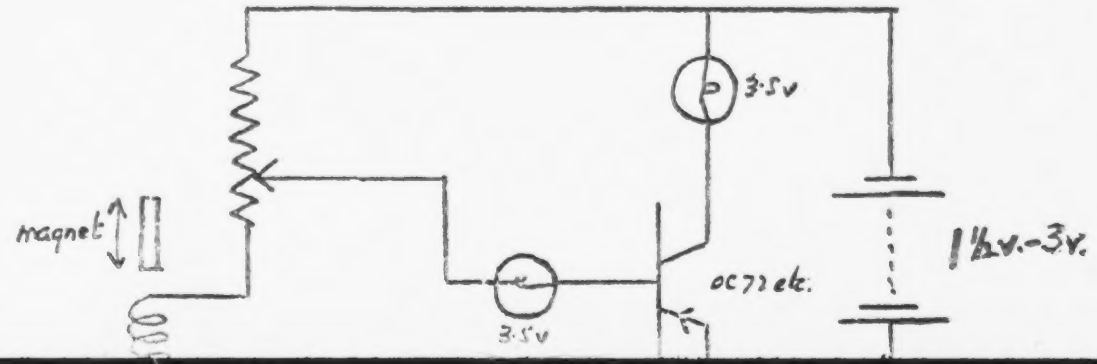
DIAGRAM. 6.



Note:- Move magnet in and out of coil.

DIAGRAM. 7.



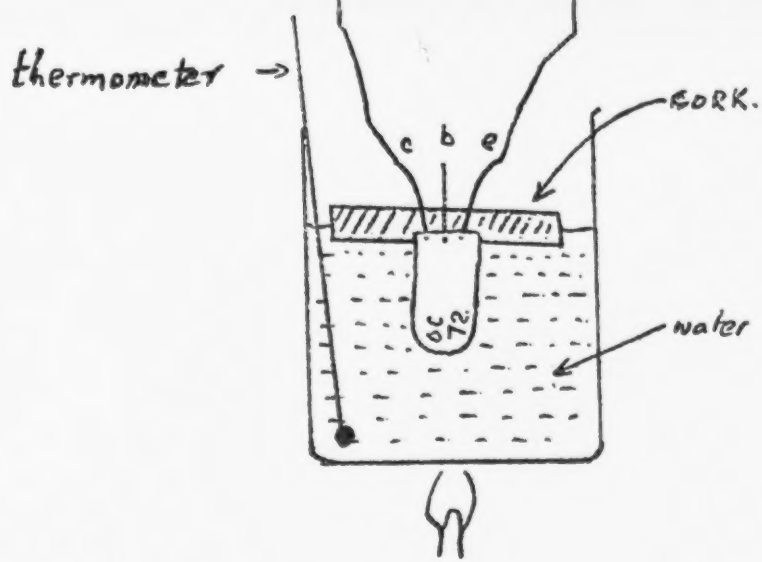


DIAGRAM. 9.

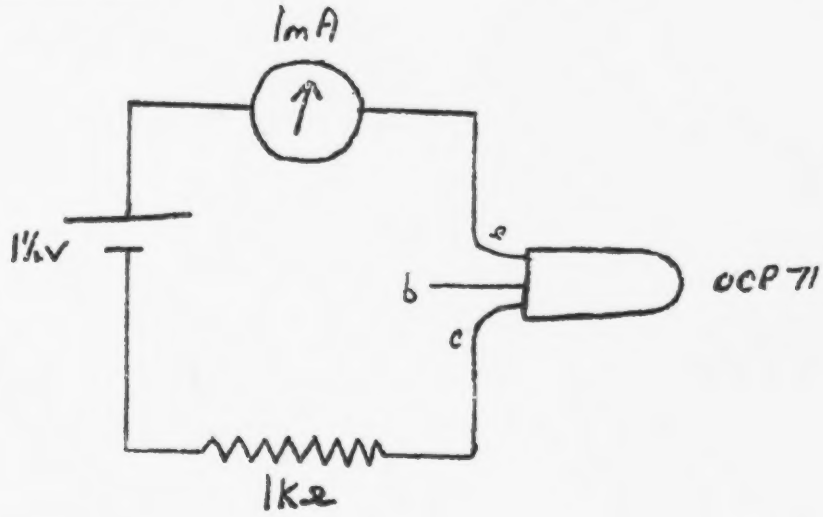


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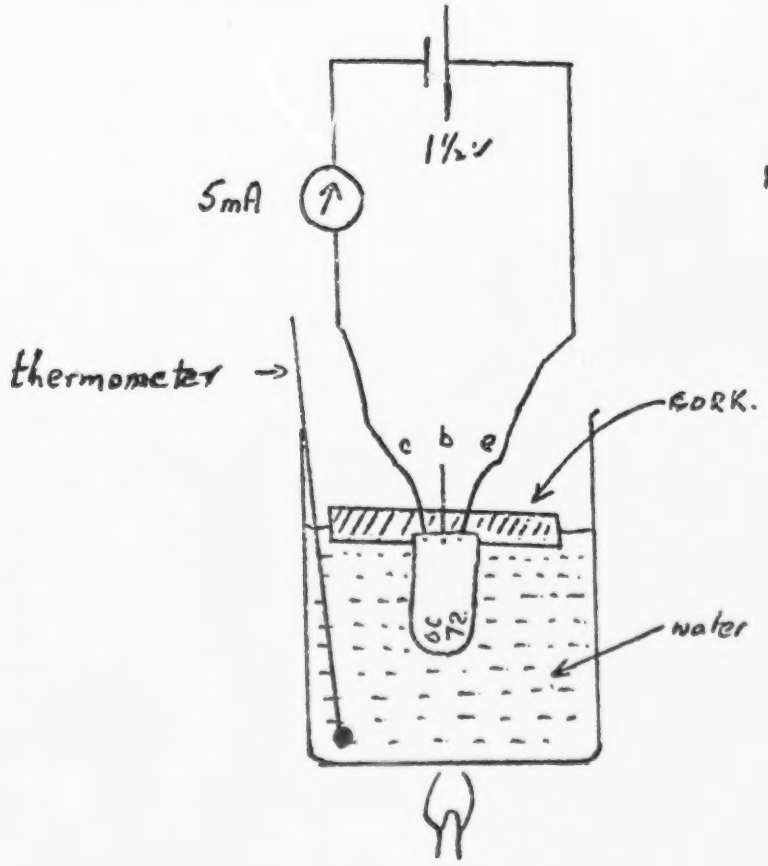
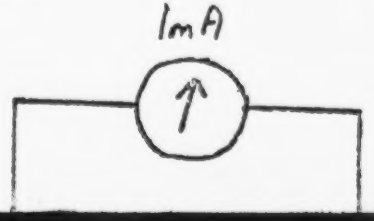
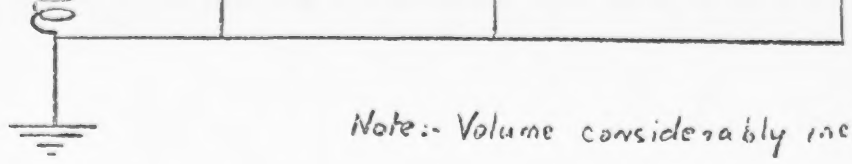
DIAGRAM. 8.



N.B. Base connection left free.

DIAGRAM. 9.





Note:- Volume considerably increased.

DIAGRAM. 11.

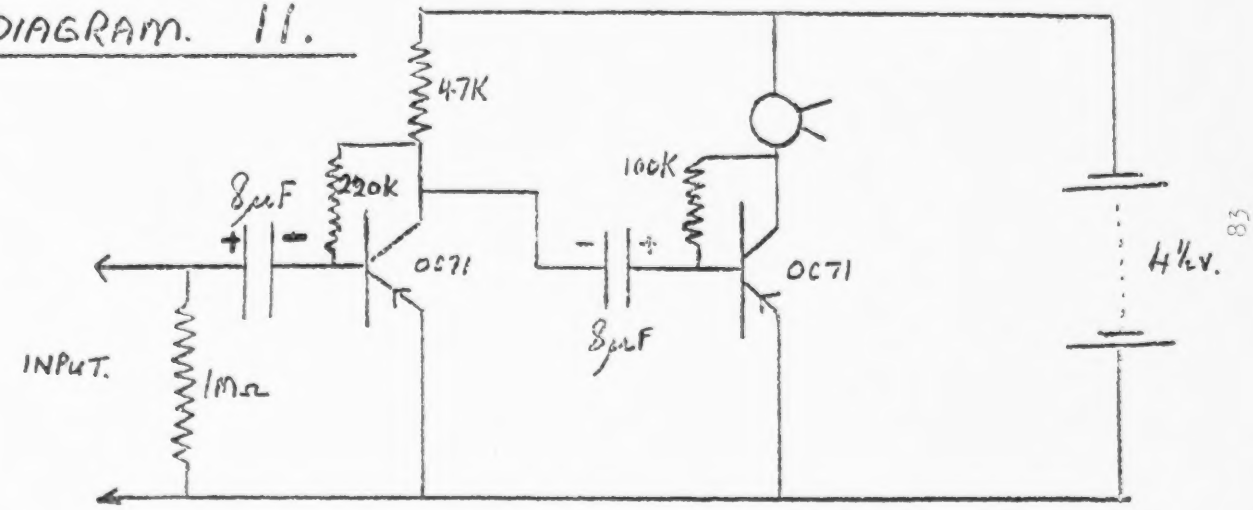


DIAGRAM. 12.

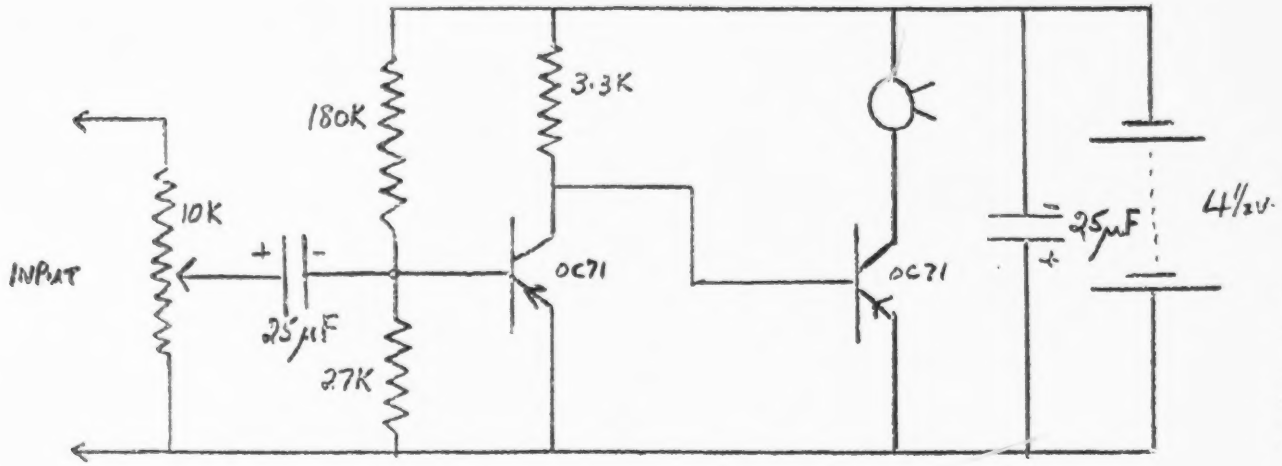


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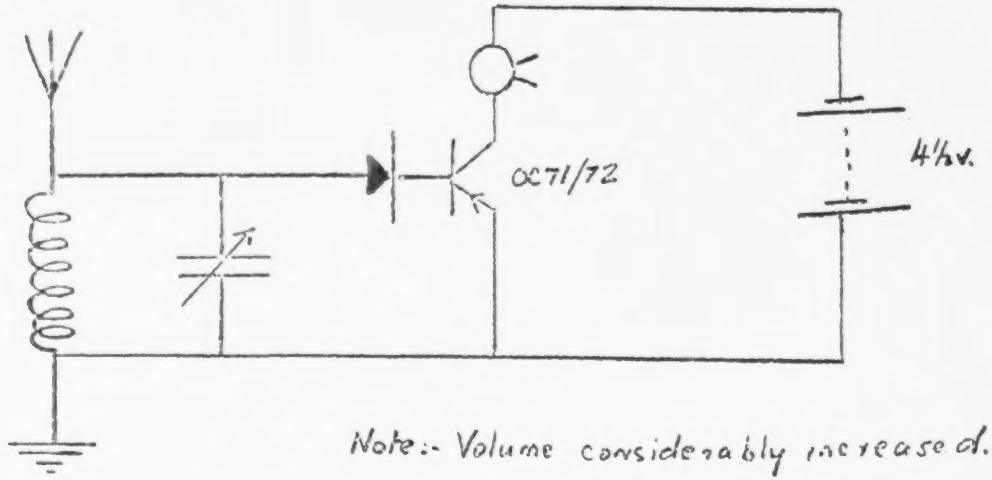
DIAGRAM. 10.



Note:- Volume considerably increased.

DIAGRAM. 11.

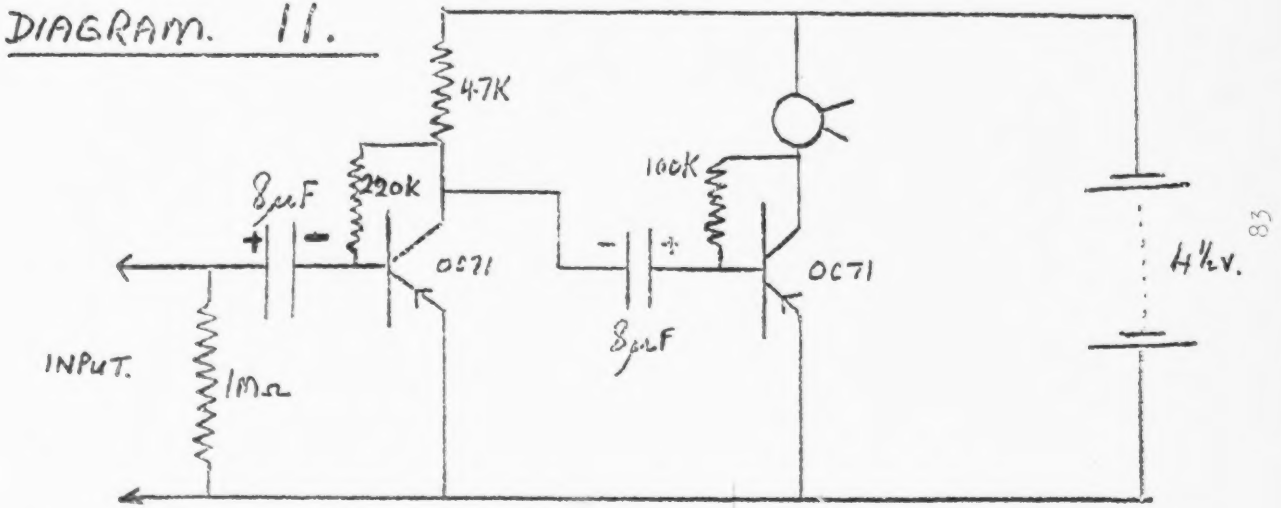
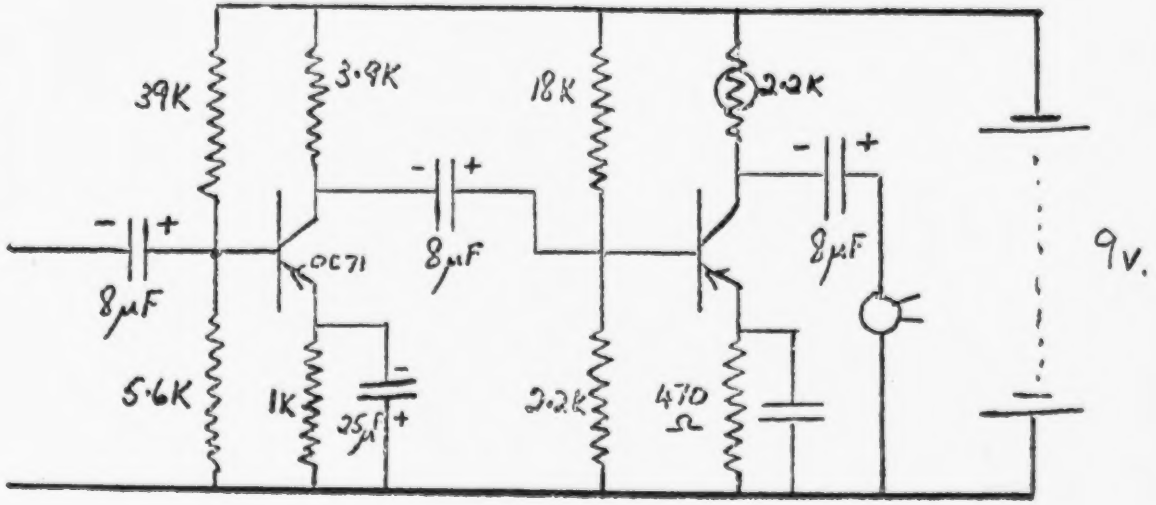


DIAGRAM. 12.

DIAGRAM 13.



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